JOURNAL
OF
THE FRANKLIN INSTITUTE
OF THE
State of Pennsylvania
AND
AMERICAN REPERTORY.

MAY, 1844.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Short methods of calculating correctly the Sectional Areas of Excavations, or Embankments. By SOLOMON W. ROBERTS, C.E.

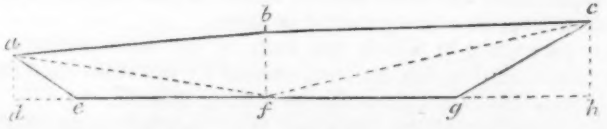
In the construction of most canals and railroads a large number of calculations are required of the sectional areas of excavations and embankments, many of which (called cross-sections of three cuttings) have the general form of the figure *a b c g e;* the depths of the cutting, or filling, being taken at the points *a*, *b*, and *c*. The point *b*, is in the centre line, and *a* and *c*, are the points where the side slopes strike the surface of the ground.

The three following methods, devised some years since, for accurately and readily obtaining such areas, are well adapted to facilitate the operation, and their correctness may be easily demonstrated:—

No. I.

Multiply the extreme width of the excavation, or embankment measured horizontally, by one-half of the depth at the centre; multiply the sum of the depths at the sides, by one-fourth of the base line, or bottom width *(e g,)*—the sum of these products will be the sectional area required.

Thus, in the following diagram the centre stake standing at *b:*



$$\left(dh \times \frac{bf}{2}\right) + \left(\overline{ad + ch} \times \frac{eg}{4}\right) = \text{Sectional Area of } abcgfe.$$

The diagram in this position represents an excavation, by inverting it an embankment.

No. II.

The same result may be obtained with less calculation, by the use of a table, as follows, the cuttings being taken in feet and tenths, as usual:

Prepare a table of three columns, the first containing the depths at the centre, the second the sectional areas for each depth on level ground, the third the horizontal distance from the centre stake to the side slopes—such a table may be readily constructed. Then find the difference between the centre depth, and the average of the side depths, and multiply this difference into the number in the third column of the table opposite the centre cutting. If the average of the side depths is greater than the centre depth, add this product to the number in the second column, if less, subtract it, and the result will be the cross-section required.

No. III.

The following method, after making the table, is very convenient, on account of the substitution of addition and subtraction, for multiplication and division:

Prepare a table of twelve columns, the first containing the centre cuttings for feet and tenths, and the second the sectional area for each centre cutting, when the sum of the side cuttings is equal to that at the centre. The remaining columns, numbered from 1 to 10, are to be filled by inserting in the first, half the distance from each centre stake to the side slope, measured horizontally; in the second column twice the amount in the first; in the third three times the amount in the first; and so on.

To calculate a Sectional Area by this Table.

Subtract the centre cutting from the sum of the side cuttings—suppose this difference to be 4.70, for example—then from the column numbered 4, take out the amount opposite the given centre cutting; and for the seven-tenths take the amount in the 7th column, and move the decimal point one figure to the left; add these two amounts to the number in the column of areas, and *the sum will be the sectional area required.*

If the number of feet in the difference between the centre cutting, and the sum of the side cuttings exceeds ten, the amount for ten feet must be taken from the table, and be added to that for the remaining height taken from its corresponding column.

In those rare cases in which the sum of the side cuttings is less than the centre cutting, the amount caused by the difference must be deducted from that taken from the column of areas.

The demonstration of the foregoing rules depends upon simple trigonometrical principles, and it does not require to be elucidated here.

Philadelphia, April, 1844.

The Atmospheric Railway.

The vacuum pipe, which is the distinguishing characteristic of this railway, is about fifteen inches internal diameter; it is of cast-iron, united in the same manner as the gas, or water, pipes in our streets, and is laid in the centre between the two rails. A simple cutter is passed through the pipes when they come out of the foundry sand; and being raised to the temperature of melting tallow, a mop dipped in this material is passed through them, and being followed by a wooden piston, the inside becomes coated with a thin surface of tallow, which soon acquires considerable hardness; so that, practically, the traveling piston moves in a tube of tallow, and this method is found very effectual in preventing atmospheric leakage. On the top of the tube is a narrow opening, extending the whole length, which is closed with a valve for the purpose of rendering the tube air-tight when required. This valve is a continuous flap of leather, on the upper and under sides of which are riveted plates of iron, the inner surface of the lower plate being so shaped as to form, when the valve is closed, a portion of the circumference of the pipe; the upper plate and the leather being both a little wider than the opening, or "slot," and made to extend over it on each side. This continuous valve is hinged on one side to a projecting rib; and the other edge falls into a groove containing a mixture of wax and tallow, which, when melted, seals up the pipe, and makes it sufficiently air-tight for practical working. There is also a contrivance, called the weather-valve, for protecting the apparatus from the weather.

A reference to fig. 1, which is a cross section of the pipe when closed, will assist the reader in comprehending its structure.

Fig. 1.

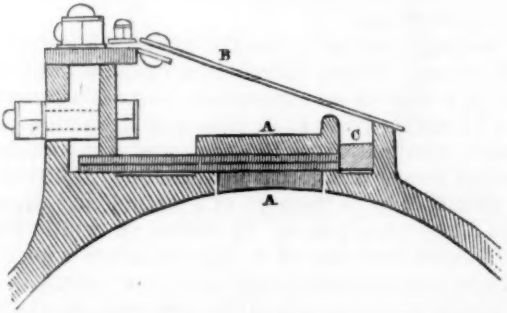
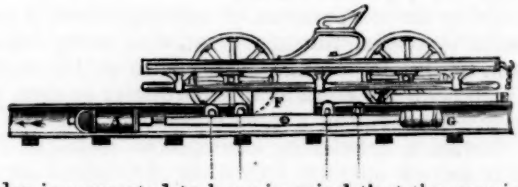


Fig. 1, is a transverse section of the upper part of the vacuum pipe when the valves are closed. A A, is the air-tight valve; B, the weather valve; and C, the composition of wax and tallow, or other suitable ingredients.

Within the pipe described is a piston, with a rod fourteen, or fifteen, feet in length, to which are attached rollers for opening the air-tight

valve at the rear of the piston, not in front, as it advances along the pipe. A "coulter" connects the piston to the driving car, as the first carriage is called; and to this car is connected a copper vessel several feet in length, heated with coke, for the purpose of melting the wax when the valve has been pressed down by the apparatus for that purpose, (see fig. 2.)

Fig. 2.



The reader is requested to bear in mind that the moving force depends upon the *difference* of pressure before and behind the piston. So long as these two forces are in equilibrium, they counterbalance each other; and there is no propulsive power. But disturb this equilibrium, destroy this balance of power, and we at once call into action an existing, but hitherto dormant, force, varying in amount with the extent to which the equilibrium has been destroyed. When, therefore, the vacuum pump has exhausted the air in front of the piston to the extent of 15 inches by the mercurial gauge, there is a pressure in front of half an atmosphere, say 7½ lbs. to the square inch; but the pressure behind has not been disturbed; it is still a whole atmosphere, say 15 lbs. to the square inch; the propulsive force is consequently the difference between these, or 7½ lbs. to the inch. If the exhaustion in front is carried to 25 inches, the remaining pressure is 5 inches; and the difference, 20 inches, indicates a propelling power of two-thirds of an atmosphere, or 10 lbs. on each square inch of the piston, being half a pound for each inch of exhaustion shown by the mercurial vacuum gauge.

Now the sectional area of a circular piston, 15 inches in diameter, is about 176 inches. When, therefore, a vacuum has been produced of 10 inches, or a third of an atmosphere, there is a power of 880 lbs.; a vacuum of 15 inches gives 1320 lbs.; and a vacuum of 20 inches, which is readily attained, gives 1760 lbs.; and it is considered that the average traction power of a locomotive is about 1000 lbs.

We may remark that as the area of a circle is in proportion to the square of the diameter, a pipe of 7½ inches in width would have a force equal to one-fourth that of a pipe 15 inches wide; a pipe of 5 inches would be only one-ninth, and so in proportion.

We have assumed the weight of the atmosphere at 30 inches, as shown by the common barometer, and the pressure at 15 lbs. to the square inch. These amounts, though not strictly accurate, are sufficiently so for our purpose. On some very fine day, when the barometer stands at 30 inches, (all barometers are thus graduated,) should the piston be loaded to the full extent of its traction power, and the weather changing very suddenly, the barometer should fall to 28 inches, (which is a possible, though quite improbable, event,) the

power of the piston would be forthwith lessened one-fifteenth. The pressure in front continues the same, but the hind force, the weight of the atmosphere, as shown by the barometer, is two inches, or one-fifteenth, less than it was. We introduce this simply as an illustration of the principle of action, not as an event that will actually occur, though from time to time the variation in the weight of the atmospheric column, and, consequently, in the pressure on the piston, is greater than that we have named.

It will now be seen, that in the atmospheric railway, the traction power depends on the sectional area of the pipe, and the amount of vacuum, or rarefaction. The speed will be in proportion to the rapidity with which the air in front of the progressing piston can be drawn, or pumped, out of the tube. This exhaustion is easily carried to 23 or 24 inches, as shown by the mercurial gauge; (a perfect vacuum being 30) it is nearly simultaneous in the whole length of the pipe, and an exhaustion of 15 inches has been procured in less than two minutes. A speed has been attained of 50 or 60 miles an hour, and even 80, with a single carriage; and at this rapid rate the sealing apparatus performed its duties perfectly.

Fig. 3.

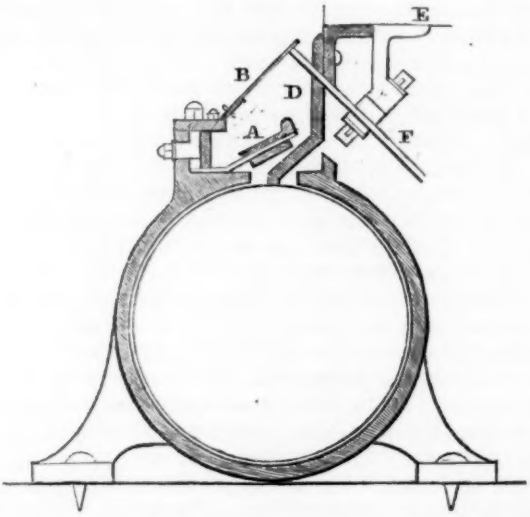


Fig. 3, is a transverse section of the vacuum pipe, with the valves open. A, the air-tight valve; B, the weather valve; D, the connecting arm, or coulter; E, part of the driving carriage; F, roller to open the weather valve.

To prevent confusion, the rollers for opening the air-tight valve are not shown in this drawing, figure 3; they may be seen in the longitudinal section, (figure 2,) in which the piston A, is seen traveling in the direction of the arrow. As it advances the two

small rollers B B, lift up the air-tight valve, which, when the coulter F, has passed, is allowed gradually to fall into the groove again, by the corresponding rollers C C, and is firmly pressed down into its right position by the upper roller D. The long heater E, follows, and melting the wax, (shown at C, in fig. 2,) re-seals the pipe; F, is the connecting arm, or coulter; and G, is the weight to counterbalance the piston. Between the carriage wheels is shown the seat for the conductor. (The roller for opening the weather valve will be seen in fig. 3.)

The pipe at the higher end is connected with a large air pump, worked by a stationary engine at Dalkey, for the purpose of exhausting, or, more correctly, partially exhausting, this pipe, and thereby causing, as we have before explained, a pressure at the opposite end. This pump is about 5½ feet in diameter, or nearly twenty times the sectional area of the pipe; the length of the stroke is also about 5½ feet, and when working it moves at the rate of 240 feet per minute. It is double acting.

Now the carriages being attached to the piston at Kingstown, and the air being pumped out of the tube, it is clear, that if the pressure is sufficiently great on the piston, the driving carriage must go forward. The train moves—the driving car, or piston carriage, opens the sealed valve—the apparatus for this purpose again presses the valve into its proper channel—the heater follows and seals it up—the engine continues to work the air-pump, to maintain the partial vacuum—the train arrives at its destination—and the pipe is ready sealed for a repetition of the same process.

The return voyage is to be performed without any power save that of gravitation. The carriages are to convey themselves down the line, and also the piston, which, not being needed in the descending journey, is placed outside, as horses are sometimes taught to mount a low truck when their power is not wanted. This contrivance also saves a needless working of the valves. On such an incline, (an average of 1 in 115, in some parts much steeper,) this will be easily effected, at a rate probably of 20 to 30 miles an hour. The writer of this article was, some time since, on a line of railway, which, though not designed for passengers, was in very good condition; and wishing to proceed four or five miles down an incline, much less steep than the Dalkey Railway, an empty wagon was attached to two loaded ones; they started, the motion was very easy, and as he stood on the wagon he found, very unexpectedly, that they had attained a speed of more than 30 miles an hour. Standing on an open truck, this was an unwarrantably dangerous rate, which he would not knowingly have attained.

To this description of the Atmospheric Railway we will add a few words relative to its history and progress.

The first suggestion of such a mode of transit is attributed to Papin, more than a century since. In recent times have followed Lewis, Vallance, Medhurst, Pinkus, and lastly, Clegg and Samuda. Professor Vignoles states, in 1842, that it was "Medhurst who, about thirty years since, first gave to the world the right idea of connecting the

body in the pipe, or tube, directly acted upon by the atmospheric power, with a carriage moving along exteriorly." He published several pamphlets on the subject, which did not attract much attention.

Mr. Vallance took out a patent, we believe, in 1824, and he constructed a pneumatic tunnel at Brighton, of about two hundred yards long, for experimental purposes, of sufficient capacity to contain a passenger carriage.

In 1834, Mr. Pinkus took out a patent, adopting the small tube suggested by Mr. Medhurst, and proposing to cover the aperture in the pipe with a rope. This plan, as we have stated, was not found sufficiently air-tight.

Lastly came Mr. Clegg, who, still adopting Medhurst's small tube, patented the beautifully simple apparatus which is the subject of this paper; and which is said to be quite calculated to endure the rough usage necessarily attendant on so rapid motion.

The half mile of experimental line erected on this principle, at the expense of the patentees, on the West London Railway, had been exhibited for many months without attracting much attention, when it was seen by James Pim, Jr., Esq., the Treasurer of the Dublin and Kingstown Railway, who at once warmly espoused the cause of the patentees, and addressed a letter to the President of the Board of Trade, urging the Railway department of that board to institute due inquiry into this new application of the atmospheric pressure. He says, "this claim is not made lightly, nor without a suitable feeling of responsibility; it has resulted from a careful and prolonged investigation, and from repeated experiments on the West London Railway, in which I have been assisted by many of the most distinguished men of science, and by several eminent practical engineers, whose concurrent opinions have led me to such a perfect conviction of the importance of the subject, as to induce this application."

He was successful; and the commissioners' report was so far satisfactory, that, as we have stated, Government consented to advance the money.

We should not omit to add, that the electric telegraph, by which signals can be transmitted with the speed of light itself, is to be a companion of the atmospheric railway.

Several distinguished foreigners have visited Kingstown; and M. Mallet, who was appointed by the French Government to visit the Dalkey line, has presented a report to the Minister of Public Works, recommending the government to construct a line of several miles in length, so as to require three or four stationary engines, for the purpose of testing the value of the invention, as he considers the future prospects of railways in France greatly concerned in the question.

London Sat. Mag.

Statistics of the Coal Trade.

The annual statement of the quantity of coals, culm, and cinders, imported into the port of London during the year 1843—specifying

the quantity of each description—has just been published, of which the following is a summary:—

	Ships.	Tons.
Newcastle coal,	1871	631,884
Ditto Wall's End,	1724	505,153
Sunderland coal	45	13,693
Ditto Wall's End,	2329	684,680
Stockton coal,	16	3,107
Ditto Wall's End,	1963	518,813
Scotch,	148	12,108
Yorkshire,	712	71,034
Small coal,	15	4,127
Welsh,	307	79,924
Blyth,	421	98,622
Sundry places,	2	190
Totals,	9553	2,623,335

Of culm there has been imported, in 9 ships, 1801 tons; and of cinders, in 31 ships, 3384 tons—making an aggregate total of 9593 ships, and 2,628,520 tons. These returns show a falling off, (as compared with 1841, in which was sold in the London market 2,909,144 tons—the largest quantity ever imported in one year,) of 270,624 tons; and, as the above quantity averages about 270 tons per cargo, it may be estimated that 1000 coal vessels, or about one-tenth, have been unemployed in that trade during 1843, which were so employed in the year 1841. In 1842, the quantity was intermediate — viz., 2,723,200 tons—showing a gradual decrease; and it would be an interesting inquiry to ascertain the cause of such diminution of consumption, with a two years' increase of population, probably 100,000, and how far it may be connected with the stagnant state of trade—the want of employment, and consequent distress of the people.

Lond. Mining Journ.

On the principal cause of the Rocking Motion of Locomotive Engines and Carriages. By G. Heaton.

Mr. G. Heaton's paper "On the principal cause of the rocking motion of Locomotive Engines and Carriages," was read January 31st, and several experiments, with machines made for the purpose, were shown by way of illustration.

Mr. Heaton's attention was first drawn to the subject early in the year 1838, when employed to examine a steam engine and machinery used for making boiler plates, rolled bars, &c. He found that the fly wheels of the engine, when revolving rapidly, made a very rumbling noise, and the lighter one would jump as high as the glad would let it; indeed, the whole building rocked when the machinery was in motion. It was found that the fly wheels were heavy sided, and that the smaller one, 16 feet in diameter, required 160 lbs. on one side, and the larger one, 18 feet in diameter, 322 lbs. to equipoise them. This having been done, the whole of the machinery moved easily

and quietly. This result caused the author to turn his attention to the rocking and jumping motion experienced in locomotive engines and carriages. The difference of speed at which the different parts of a wheel in motion progress, or the speed at which bodies descend through short distances, does not appear to have been taken sufficient notice of by engineers, as the heavy side of a wheel has to fall at certain intervals during its revolution sixty times as fast as it would fall by gravity alone. When a railway engine is traveling at the rate of 33 miles per hour, the top of its wheel is thrown forward at the rate of about 92 feet, and downward at the rate of 46 feet in a second. Railway carriage wheels are frequently 6 to 7 lbs. heavier on one side than on the other: it is no wonder, therefore, that the unpleasant motion experienced while traveling in carriages so circumstanced, is so often complained of. Without entering into detail with regard to the different machines used for the purpose of illustrating Mr. Heaton's views, it may be well to describe the most simple one, and the method of making the experiments. The model is made to represent the wheels and axle of a railway carriage, the axle being 16 inches long, and the wheels 6¼ inches diameter. By placing some loose pieces of iron inside the rims, so as to represent wheels which are $\frac{1}{8}$th of an inch thicker on one side than the other, the thick side of one wheel being placed opposite the thick side of the other, at the opposite ends of the axle, according to the common practice, and the wheels allowed to revolve, the model will continue to jump about the table, on which it is placed, so long as the wheels are in motion. Again, if the pieces of iron be all placed on the same side of the centre, the model will not rock as before, but jump up and down, and make more evolutions than in the last case. The wheels being perfectly equilibrated, will revolve without any oscillating movement, and the frame remain quite steady, the number of revolutions, with the same power, being considerably increased. The paper was accompanied by tables, showing the effects produced by the experiments made under different circumstances.

February 14.—Mr. Heaton continued his experiments illustrative of the principal cause of the rocking motion of railway engines and carriages. The machine by which these experiments were shown, consists of a cam ring, having four sets of cams on its periphery, viz., one set of sixteen cams, one set of eight cams, one set of four cams, and one set of two cams. When the cam ring is made to revolve, the cams raise a rod of iron 12 inches long, and supported at one end by a cross bar fixed between the centres; when the rod is fixed for the sixteen cams, it is raised three-fourth of an inch by each cam, and strikes (after the manner of a forge hammer) 292 blows per minute, or travels at the rate of 7⅓ inches in a second, and no faster. When fixed for eight cams, to raise it 1½ inch high, the rod strikes 224 blows per minute, or travels at the rate of 11⅓ inches per second. When fixed for four cams, to raise it 3 inches high, the rod will strike 170 blows per minute, or travel at the rate of 17 inches per second—a half pound weight being fixed close to the end of the rod which is raised by the cam, two additional blows will be struck in one minute

more than when the rod is not thus loaded—and if the half pound weight be removed, and a two pound weight be fixed near to the centre of the rod, so as to require the same weight to raise it by each cam, it will strike 233 blows in a minute, or travel at the rate of 25½ inches in one second, showing that the one end of the rod working on the centres does not retard the falling of the rod lifted by each cam. Other experiments were made with the same machine with modifications, from which it appears that the small iron rod travels as fast as a forge hammer ordinarily used—that the velocity of a body falling short distances, is doubled when passing through double the distance—that allowance should be made for the momentum of the piston, piston-rod, and slide of a locomotive engine—and showing that a great loss of power is sustained by the wheels being heavy sided.—*Trans. Soc. Arts.*

Lond. Athenæum.

The Liverpool Screw.

A paper by Mr. J. Grantham, was read February 13th, describing a series of experiments on an iron vessel called the Liverpool Screw: This boat was 65 feet long, 12 feet 6 inches beam, and had 3 feet 9 inches draught of water. She was propelled by two high pressure oscillating engines, with cylinders 13 inches diameter, and 18 inches stroke. The pressure of the steam in the boiler varied from 50 lbs. to 60 lbs. per square inch; and it was cut off at one-fourth of the length of the stroke, working the remainder by expansion. The nominal power was 20 horses, but it did not really exceed 18½ horses. The cylinders were placed diagonally, with both the piston rods working upon the same crank; the driving shaft being beneath the cylinders, and running direct to the propeller, without the intervention of either gearing, or bands. The screw propeller was enlarged three times, and, at last, was left at 5 feet 4 inches diameter by 20 inches in length. It was set out with a pitch expanding from 10 to 11 feet, on Woodcroft's plan. It was made of wrought-iron, with four short arms with broad shovel ends, whose united area was 16 square feet, 13 feet only of it being immersed, as some portion of the arms was constantly above water. The angle of the centre of the float was 45°. The speed of the propeller was generally 95 revolutions per minute. With these dimensions, the speed attained was described as 10½ statute miles per hour. The amount of "slip" of the screw in the water, as ascertained by Massey's log, was stated not to exceed 5 per cent. Several experiments were detailed, which showed that there was not more tendency to "list," or to turn round, by the action of the screw, than with paddle wheels; and the vessel was said to have excelled all the other steamers of the port of Liverpool, in towing out vessels in a rough sea. Designs were submitted on this principle for a steam frigate, and for large steamers, working with oscillating cylinders direct upon the main shaft.

February 20.—The discussion on the "screw propeller" was re-

sumed. Mr. Grantham explained the construction of the propeller used on board the *Liverpool Screw.* It was formed of four arms with broad shovel ends, set at an angle of 45°, and, from his account, its action appeared to have been satisfactory; he also spoke highly of Ericsson's form of propeller, as better adapted, for large diameters, than any other kind. This statement was confirmed by Mr. Braithwaite, who promised, at a future meeting, to give the results obtained on board the *Princeton* steamer, United States, America.—*Trans. Inst. Civ. Eng.* Ibid.

The Thames Tunnel.

This great national undertaking having been completed, it stands forth a monument, not only of the science and perseverance of the engineer, Sir I. M. Brunel, but of the spirit and enterprize of the country. It may not be uninteresting to our readers to consider, in this place, the circumstances which gave rise to its formation, the difficulties which occurred in the course of its construction, and the expense incurred in working out the project. It would appear that the immense traffic carried on by various mercantile concerns below London Bridge, suggested to the minds of many intelligent engineers the desirability of constructing a communication from shore to shore, for the purpose of affording the necessary facilities to carry out the traffic in question with greater convenience to the parties engaged in it, particularly as regarded the saving of time, so important an ingredient in the commercial and mercantile affairs of this great metropolis. From the number and magnitude of the shipping constantly passing on the river, a bridge was out of the question, and the only plan that could be resorted to that would be free from objections on the ground of injury, or inconvenience, to the navigation of the Thames, was a tunnel under its bed. It seems that in 1799, a project was put forth for the formation of a tunnel at Gravesend, but the scheme was soon abandoned. In 1804, an attempt was made to construct a tunnel from Rotherhithe to Limehouse, and although a drift-way was carried under the river to the extent of 923 feet, and within 150 feet of the opposite shore, the work was abandoned, owing to difficulties that had occurred, and which the engineer declared at the time to be insurmountable. The plan of a tunnel under the river was, however, always looked upon as a matter of deep interest, and great importance, and when Sir I. M. Brunel, in 1824, exhibited his plan for constructing one with a double and capacious roadway, it was not only well received, but liberally supported by men of the first rank, both as regards station in society, and attainments in science. No one seems to have given it more cordial assistance than the Duke of Wellington, who was amongst the original subscribers to it. His Grace described it as "a work important in a commercial, as well as in a military and political point of view," and added, "that there was no work upon which the public interest of foreign nations had been more excited than upon this tunnel." The spot selected for the for-

mation of the work in question—namely, from Rotherhithe to Wapping—was considered to be the most desirable, not only as regarded the traffic in the immediate neighborhood of the tunnel, but also as related to the neighboring counties. An act of Parliament having been obtained on the 24th of June, 1824, and £180,000 having been raised by means of shares, Sir I. M. Brunel, the engineer, began his operations; but it was not until the 1st of January, 1826, that the shield by which the tunnel was to be worked was placed at the bottom of the shaft formed for its reception. The double archway of the tunnel was then proceeded with; but, on the 25th of the same month, the stratum of clay through which the work was being carried forward, broke off abruptly, and for six weeks the shield was left open to a considerable influx of land water. The consequence was that the progress of the work was much impeded. However, on the 11th of March following, the break in the clay having been passed, the work was proceeded with, and by the 30th of April, 1827, the tunnel had extended 400 feet under the river, and was fully and substantially completed with brick work. In the month of May, 1827, and again in January, 1828, the river broke in, and great apprehensions were entertained that this unprecedented undertaking must be abandoned. When, however, the chasms in the bed of the river had been filled up with bags of clay, and the water in the tunnel cleared out, it was found that the structure was in a perfectly sound and satisfactory state. These circumstances, however, and the entire expenditure of the capital of the company, prevented the work from being proceeded with until the year 1835, when a grant of public money was made by the treasury, through the Exchequer Loan Commissioners, to the company to complete the undertaking. The work was then proceeded with, and the result is the perfect completion of the tunnel, which is 1200 feet in length. The time occupied in the execution of the work was about nine years. The actual tunnel was completed in eight years. In addition to the £180,000 expended by the company, the treasury has advanced £270,000, making the total cost of the tunnel, up to the present moment, £450,000. The carriage way descents have yet to be formed, and it is estimated by Mr. Walker, that the cost of these descents will amount to £130,000, or £140,000, more. So that when the tunnel is perfect in all its parts, its total cost will be somewhere about £600,000. It appears that the returns from the tolls for foot passengers for the present year, are calculated at £15,000, and that the average for future years is estimated at £10,000, and this, with the tolls upon carriages, when the ways are formed, is considered likely to give not only to the proprietors a fair interest for their capital, but also to the Treasury for the sums advanced on the part of the public. How this may be, time will show, and with this brief notice of this truly unparalleled enterprize, we leave the matter in the hands of the public.

Mining Journal.

American Patents.

Information to persons having business to transact at the Patent Office.

Sec. 1. The existing laws relating to patents, are those approved July 4, 1836, March 3, 1837, March 3, 1839: all former acts having been repealed by the act of 1836.

Sec. 2. "Patents are granted for any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement on any art, machine, manufacture, or composition of matter, not known, or used, by others before his, or their, discovery, or invention thereof, and not, at the time of his application for a patent, in public use, or on sale, with his, or their, consent, or allowance, as the inventor, or discoverer."—Act of 1836, section 6. "No patent shall be held to be valid by reason of the purchase, sale, or use, [of the invention] prior to the application for a patent, as aforesaid, except on proof of abandonment of such invention to the public, or that such purchase, sale, or public use, has been for more than two years prior to such application for a patent."—Act of March 3, 1839.

Sec. 3. The term for which a patent is granted is fourteen years; but it may, under certain circumstances, be renewed for seven years, as hereinafter mentioned.

Sec. 4. Patents are granted to citizens of the United States, to aliens who shall have been resident in the United States one year next preceding, and shall have made oath of their intention to become citizens thereof, and also to foreigners who are inventors, or discoverers.

Sec. 5. A patent may be taken out by the inventor in a foreign country, without affecting his right to a patent in the United States, provided the invention has not been introduced into public and common use in the United States prior to the application for such patent. In every such case the patent is limited to fourteen years, from the date of the foreign letters patent. A patent is not granted upon introduction of a new invention from a foreign country, unless the person who introduced it be the inventor, or discoverer. If an alien neglects to put, and continue on sale, the invention in the United States, to the public, on reasonable terms, for eighteen months, the patentee loses all benefit of the patent.

Sec. 6. Joint inventors are entitled to a joint patent, but neither can claim one separately.

Sec. 7. An inventor can assign his right before a patent is obtained, so as to enable the assignee to take out a patent in his own name; but the assignment must be first entered of record; and the application, therefore, must be duly made, and the specification signed, and sworn to by the inventor. And in the case of an assignment by a foreigner, the same fee will be required as if the patent issued to the inventor.

Sec. 8. The assignment of a patent may be to the whole, or to an

undivided part, "by any instrument in writing." All assignments, and also the grant, or conveyance, of the use of the patent in any town, county, state, or specified district, must be recorded in the Patent Office within three months from the date of the same. But assignments, if recorded after the three months have expired, will be on record as notice to protect against subsequent purchases. No fee is now charged for recording assignments. Patents, grants, and assignments recorded prior to the 15th of December, 1836, must be recorded anew before they can be valid as evidence of any title. This is also done free of expense.

SEC. 9. In case of the decease of an inventor, before he has obtained a patent for his invention, "the right of applying for and obtaining such patent shall devolve on the administrator, or executor, of such person, in trust for the heirs-at-law of the deceased, if he shall have died intestate; but if otherwise, then in trust for his devisees, in as full and ample manner, and under the same conditions, limitations, and restrictions, as the same was held, or might have been claimed, or enjoyed, by such person in his, or her, lifetime; and when application for a patent shall be made by such legal representatives, the oath, or affirmation, shall be so varied as to be applicable to them." Act of 1836, section 10.

SEC. 10. The Patent Office will be open for examination during office hours, and applicants can personally, or by attorney, satisfy themselves, on inspection of models and specifications, of the expediency of filing an application for a patent.

SEC. 11. All fees received are paid into the treasury, and the law has required the payment of the patent fee before the application is considered; two-thirds of which fee is refunded on withdrawing the application. But no money is refunded on the withdrawal of an application, after an appeal has been taken from the decision of the Commissioner of Patents. And no part of the fee paid for caveats, and on applications for the addition of improvements, reissues, and appeals, can be withdrawn.

SEC. 12. It is a frequent practice for inventors to send a description of their inventions to the office, and inquire whether there exists any thing like it, and whether a patent can be had therefore. *As the law does not provide for the examination of descriptions of new inventions, except upon application for a patent, no answers can be given to such inquiries.*

On the Application for a Patent.

SEC. 13. No application can be examined until the fee for the patent is paid, and the specification, model, and drawings filed.

SEC. 14. The application for a patent must be made by petition to the *Commissioner of Patents*, signifying a desire of obtaining an exclusive property in the invention, or discovery, and praying that a patent may be granted therefor, as in the form annexed hereto; *which petition should be signed by the inventor.*

Description, or Specification.

SEC. 15. Before any inventor shall receive a patent for any such

new invention, or discovery, he shall deliver a written description of his invention, or discovery, and of the manner and process of making, constructing, using, and compounding the same in such full, clear, and exact terms, avoiding unnecessary prolixity, as to enable any person skilled in the act, or science, to which it appertains, or with which it is most nearly connected, to make, construct, compound, and use the same, and in case of any machine, he shall fully explain the principle, and the several modes in which he has contemplated the application of that principle, or character, by which it may be distinguished from other inventions; he shall particularly specify and point out the part, improvement, or combination, which he claims as his own invention, or discovery."—Act of 1836, sec. 6. [See form annexed.]

Sec. 16. It is important, in all cases, to have the specification describe the sections of the drawings, and refer by letters to the parts; duplicate drawings being required.

Sec. 17. A *defective* specification, or drawing, may be amended at any time before a patent has issued; in which case the applicant will be required to make oath anew.

On New Improvements.

Sec. 18. "Whenever the original patentee shall be desirous of adding the description and specification of any new improvement of the original invention, or discovery, which shall have been invented, or discovered, by him subsequent to the date of his patent, he may, like proceedings being had in all respects as in the case of original applications, and on the payment of fifteen dollars, as hereinafter mentioned, have the same annexed to the original description and specification; and the Commissioner shall certify, on the margin of such annexed description and specification, the time of its being annexed and recorded; and the same shall thereafter have the same effect in law, to all intents and purposes, as though it had been embraced in the original description and specification."—Act of 1836, section 13.

Sec. 19. In all such cases the claim in the original patent is subject to a re-examination; and if it shall appear that any part of the claim was not original at the time of granting the patent, a disclaimer of said part must be filed in the Patent Office, or the specification of claims restricted, by having the patent reissued, before the improvement can be added. And if there is not anything which can be claimed, the improvement can not be added, but may be secured by a separate patent, on the payment of the fee of thirty dollars. If the patent was granted before the 15th of December, 1836, a model and drawings of the invention, as first patented, verified by oath, must be furnished, unless dispensed with by the Commissioner.

Sec. 20. No patent for an improvement can be granted to the original inventor, assignee, or possessor, of a patent granted before the 15th of December, 1836, until a model and drawings of the invention, as originally patented, verified by oath, shall have been deposited, unless dispensed with by the Commissioner.

Sec. 21. "Every inventor, before he can receive a patent, must

make oath, or affirmation, that he does verily believe that he is the original and first inventor, or discoverer, of the art, machine, manufacture, composition, or improvement, for which he solicits a patent; and that he does not know, or believe, that the same was ever before known, or used; and also of what country he is a citizen."—Act of 1836, sec. 6. [See form annexed.] In every case the oath, or affidavit, must be made before a person having general powers to administer oaths. Justices of the Peace have not, in all cases, this general power.

SEC. 22. If the applicant be an alien, and have resided one year in the United States next preceding the application, and have given legal notice of his intention to become a citizen of the United States, he must make oath to these facts before he can apply for a patent for the same fee as that paid by a citizen.

Of Drawings.

SEC. 23. The law requires that "the applicant for a patent shall accompany his application with drawings, and written references, *when the nature of the case admits of drawings.*" These drawings should, in general, be in perspective, and neatly executed; and such parts as can not be shown in perspective, must, if described, be represented in section, or detail. Duplicates of them are required, as one must accompany the patent when issued, as explanatory of it, and one must be kept on file in the office.

SEC. 24. The drawings must be signed by the patentee, and attested by two witnesses, except when the specification describes the sections, or figures, and refers to the parts by letters; in which case they are neither required to be signed, nor accompanied by written references upon the drawings, the whole making one instrument. Drawings are absolutely necessary, when the case admits of them.

SEC. 25. An examination, as to originality of invention, may be made on a single drawing; but duplicates will be required before the patent issues.

Of Models, and Specimens of Ingredients.

SEC. 26. The law requires that the inventor shall deliver a model of his invention, or improvement, when the same admits of a model. The model should be neatly made, and as small as a distinct representation of the machine, or improvement, and its characteristic properties will admit; the name of the inventor should be printed, or engraved upon, or affixed to it in a durable manner. Models forwarded without a name, cannot be entered on record, and are, therefore, liable to be lost, or mislaid.

SEC. 27. When the invention is of "a composition of matter," the law requires that the application be accompanied with specimens of the ingredients, and of the composition of matter, sufficient in quantity for the purpose of experiment.

On Granting Anew Lost Patents.

SEC. 28. The third section of the act of Mach 3, 1837, provides:

"SEC. 3. *And be it further enacted,* That whenever it shall appear

to the Commissioner that any patent was destroyed by the burning of the Patent Office building on the aforesaid fifteenth day of December, or was otherwise lost prior thereto, it shall be his duty, on application therefor by the patentee, or other person interested therein, to issue a new patent for the same invention, or discovery, bearing the date of the original patent, with his certificate thereon, that it was made and issued pursuant to the provisions of the third section of this act, and shall enter the same of record: ***Provided, however,*** That before such patent shall be issued, the applicant therefor shall deposit in the Patent Office a duplicate, as near as may be, of the original model, drawings, and description, with specification of the invention, or discovery, verified by oath, as shall be required by the Commissioner; and such patent, and copies of such drawings and descriptions, duly certified, shall be admissible as evidence in any judicial court of the United States, and shall protect the rights of the patentee, his administrators, heirs, and assigns, to the extent only in which they would have been protected by the original patent and specification."

Proceedings on Application for Patents, and on Appeals from Decision of the Commissioner. (Act of 1836, sec. 7.)

SEC. 29. "That on the filing of any such application, (consisting of petition, specification, model, and drawings, or specimens,) and the payment of the duty hereinafter provided, the Commissioner shall make, or cause to be made, an examination of the alleged new invention, or discovery; and if, on such examination, it shall not appear to the Commissioner that the same had been invented, or discovered, by any other person in this country prior to the alleged invention, or discovery, thereof by the applicant, or that it had been patented, or described, in any printed publication in this, or any foreign, country, or had been in public use, or on sale, with the applicant's consent, or allowance, prior to the application, if the Commissioner shall deem it to be sufficiently useful and important, it shall be his duty to issue a patent therefor; but whenever, on such examination, it shall appear to the Commissioner that the applicant was not the original and first inventor, or discoverer, thereof, or that any part of that which is claimed as new had before been invented, or discovered, or patented, or described in any printed publication in this, or any foreign, country, as aforesaid, or that the description is defective and insufficient, he shall notify the applicant thereof, giving him briefly such information and references as may be useful in judging the propriety of renewing his application, or of altering his specification to embrace only that part of the invention, or discovery, which is new. In every such case, if the applicant shall elect to withdraw his application, relinquishing his claim to the model, he shall be entitled to receive back twenty dollars, part of the duty required by this act, on filing a notice in writing of such election in the Patent Office; a copy of which, certified by the Commissioner, shall be a sufficient warrant to the Treasurer for paying back to the said applicant the said sum of twenty dollars. But if the applicant, in such case, shall persist in his claim for a patent, with, or without, any alteration of his specification, he

shall be required to make oath, or affirmation, anew, in manner as aforesaid; and if the specification and claim shall not have been so modified, as, in the opinion of the Commissioner, shall entitle the applicant to a patent, he may appeal to the Chief Justice of the United States Court for the District of Columbia, who may affirm, or reverse, the decision of the Commissioner of Patents in whole, or in part, and may order a patent to issue; or he may have remedy against the decision of the Commissioner of Patents, or the decision of the Chief Justice of the United States Court for the District of Columbia, by filing a bill in equity in any of the United States Courts having jurisdiction, as hereinafter explained.

Reissue to Correct a Defective Description.

SEC. 30. When an applicant wishes to cancel an old patent, and to correct a mistake, or error, which has arisen from inadvertence, he should state this fact in his application, and expressly *surrender* the old patent, which must be transmitted to the Patent Office before a new patent will be issued. And no improvement, or alteration, made subsequent to the filing of the application upon which the original patent was granted, can be introduced into a patent upon reissue. Section thirteen of the act of July, 1836, enacts, "That whenever any patent, which has heretofore been granted, or which shall hereafter be granted, shall be inoperative, or invalid, by reason of a defective, or insufficient description, or specification, or by reason of the patentee claiming in his specification, as his own invention, more than he had, or shall have a right to claim as new, if the error has, or shall have, arisen by inadvertency, accident, or mistake, and without any fraudulent, or deceptive, intention, it shall be lawful for the Commissioner, upon the surrender to him of such patent, and the payment of the further duty of fifteen dollars, to cause a new patent to be issued to the said inventor for the same invention for the residue of the period then unexpired, for which the original patent was granted, in accordance with the patentee's corrected description and specification.

SEC. 31. When the original patent has been lost, before a reissue can be granted, the original patent should first be restored, (as explained in section 28 of this circular,) and then surrendered.

SEC. 32. In the reissue, the claim is subject to an examination, as in the case of original patents; and if it shall appear that any part of the claim was not original at the time of granting the patent, the reissue will not be granted, unless said part be omitted in the claim, or a disclaimer filed in the Patent Office. And if there is not anything which can be claimed, the reissue cannot be granted, and the surrendered patent cannot be returned. Where the patent was granted before the 15th of December, 1836, a model and drawings of the invention as originally patented, verified by oath, must be deposited in the Patent Office before a reissue can be granted, unless dispensed with by the Commissioner.

SEC. 33. And in case of the death of an inventor, or of any assignment of the original patent, made by him, a similar right vests in his executors, administrators, or assignees; and the patent so reissued,

together with the corrected description and specification, have the same effect and operation in law, on the trial of all actions thereafter commenced for causes subsequently accruing, as though the same had been originally filed in such corrected form before the issuing out of the original patent.

SEC. 34. On the surrender of a patent, several patents may be issued for distinct and separate parts of the invention, upon the payment of thirty dollars for every additional patent issued.

Disclaimers.

SEC. 35. The 7th section of the law of 3rd March, 1837, provides, as follows:—

"SEC. 7. *And be it further enacted,* That whenever any patentee shall have, through inadvertence, accident, or mistake, made his specification of claim too broad, claiming more than that of which he was the original, or first, inventor, some material and substantial part of the thing patented being truly and justly his own, any such patentee, his administrators, executors, and assigns, whether of the whole, or of a sectional, interest therein, may make disclaimer of such parts of the thing patented as the disclaimant shall not claim to hold by virtue of the patent, or assignment, stating therein the extent of his interest in such patent; which disclaimer shall be in writing, attested by one, or more, witnesses, and recorded in the Patent Office, on payment by the person disclaiming, in manner as other patent duties are required by law to be paid, of the sum of ten dollars. And such disclaimer shall thereafter be taken and considered as part of the original specification, to the extent of the interest which shall be possessed in the patent, or right, secured thereby, by the disclaimant, and by those claiming by, or under, him, subsequent to the record thereof. But no such disclaimer shall affect any action pending at the time of its being filed, except so far as it may relate to the question of unreasonable neglect, or delay, in filing the same."

SEC. 36. In cases of patents granted before the 15th of December, 1836, no disclaimer will be admitted for record until a model and drawings of the invention, as originally patented, verified by oath, shall have been deposited, unless dispensed with by the Commissioner.

Interfering Applications.

SEC. 37. "Whenever an application shall be made for a patent, which, in the opinion of the Commissioner, would interfere with any other patent for which an application may be pending, or with any unexpired patent which shall have been granted, it shall be the duty of the Commissioner to give notice thereof to such applicants, or patentees, as the case may be; and if either shall be dissatisfied with the decision of the Commissioner, on the question of priority of right, or invention, on a hearing thereof he may appeal from such decision, on the like terms and conditions as are provided in the case of applications for inventions not new; and the like proceedings shall be had to determine which, or whether either, of the applicants is entitled to receive a patent as prayed for."—Act of 1836, section 8.

Caveats.

SEC. 38. The law enacts, "That any citizen of the United States, or alien, who shall have been a resident of the United States one year next preceding, and shall have made oath of his intention to become a citizen thereof, who shall have invented any new art, machine, or improvement thereof, and shall desire further time to mature the same, may, on paying to the credit of the Treasury, in manner as provided in the ninth section of this act, the sum of twenty dollars, file in the Patent Office a caveat setting forth the design and purpose thereof, and its principal and distinguishing characteristics, and praying protection of his right, till he shall have matured his invention; which sum of twenty dollars, in case the person filing such caveat shall afterwards take out a patent for the invention therein mentioned, shall be considered a part of the sum herein required for the same. And such caveat shall be filed in the confidential archives of the office, and preserved in secrecy. And if application shall be made by any other person, within one year from the time of filing such caveat, for a patent of any invention with which it may, in any respect, interfere, it shall be the duty of the Commissioner to deposit the description, specifications, drawings, and model, in the confidential archives of the office, and to give notice (by mail) to the person filing the caveat of such application, who shall within three months after receiving the notice, if he would avail himself of the benefit of his caveat, file his description, specifications, drawings, and model; and if, in the opinion of the Commissioner, the specifications of claim interfere with each other, like proceedings may be had in all respects as are in this act provided in the case of interfering applications."—Act of 1836, section 12.

Extension of a Patent beyond the Fourteen Years.

SEC. 39. Section eighteen enacts, "That whenever any patentee of an invention, or discovery, shall desire an extension of his patent beyond the term of its limitation, he may make application therefor, in writing, to the Commissioner of the Patent Office, setting forth the grounds therefor; and the Commissioner shall, on the applicant's paying the sum of forty dollars to the credit of the Treasury, as in the case of an original application for a patent, cause to be published in one, or more, of the principal newspapers in the city of Washington, and in such other paper, or papers, as he may deem proper, published in the section of country most interested adversely to the extension of the patent, a notice of such application, and of the time and place when and where the same will be considered, that any person may appear and show cause why the extension should not be granted. And the Secretary of State, Commissioner of the Patent Office, and the Solicitor of the Treasury, shall constitute a board to hear and decide upon the evidence produced before them, both for and against the extension, and shall sit for that purpose at the time and place designated in the published notice thereof. The patentee shall furnish to said board a statement, in writing, under oath, of the ascertained value of the invention, and of his receipts and expenditures,

sufficiently in detail to exhibit a true and faithful account of loss and profit in any manner accruing to him from, and by reason of, said invention. And if, upon a hearing of the matter, it shall appear to the full and entire satisfaction of said board, having due regard to the public interest therein, that it is just and proper that the term of a patent should be extended, by reason of the patentee, without neglect, or fault, on his part having failed to obtain, from the use and sale of his invention, a reasonable remuneration for the time, ingenuity, and expense bestowed upon the same, and the introduction thereof into use, it shall be the duty of the Commissioner to renew and extend the patent, by making a certificate thereon of such extension, for the term of seven years from and after the expiration of the first term; which certificate of said board of their judgment and opinion as aforesaid, shall be entered on record in the Patent Office; and thereupon the said patent shall have the same effect in law as though it had been originally granted for the term of twenty-one years; and the benefit of such renewal shall extend to assignees and grantees of the right to use the thing patented, to the extent of their respective interests therein: *Provided, however,* that no extension of a patent shall be granted after the expiration of the term for which it was originally issued.

Fees Payable at the Patent Office.

Sec. 40. All fees must be paid in advance; the amount fixed by law, except in the case of drawings, the expense of which will be communicated on application for the same.

Sec. 41. Every applicant must pay into the Treasury of the United States, or into the Patent Office, or into any other of the deposit banks, a deposit to the credit of the Treasurer, on presenting his petition, or application, as follows:

Sec. 42. If a citizen of the United States, as a patent fee,	$30.00
Sec. 43. If a foreigner, who has resided in the United States one year next preceding the application for a patent, and shall have made oath of his intention to become a citizen,	30.00
Sec. 44. If a subject of the Sovereign of Great Britain,	500.00
Sec. 45. All other foreigners,	300.00
Sec. 46. On entering a caveat,	20.00
Sec. 47. On entering an application for an appeal from the decision of the Commissioner,	25.00
Sec. 48. On extending a patent beyond the fourteen years,	40.00
Sec. 49. For adding to a patent the specification of a subsequent improvement,	15.00
In case of reissues, for every additional patent,	30.00
Sec. 50. On surrender of an old patent, to be reissued, to correct a mistake of the patentee,	15.00
Sec. 51. For a disclaimer,	10.00
Sec. 52. For copies of patents, or any other paper on file, for each 100 words,	.10

Sec. 53. For copies of drawings, a reasonable sum, in proportion to the time occupied in making the same.

SEC. 54. Communications to and from the Patent Office, are free of postage.

SEC. 55. All fees under five dollars, if sent to the Commissioner of Patents, should be transmitted in specie.

SEC. 56. It is recommended to make a deposit in a specie paying deposit bank, of the fee for a patent, or other application, and to remit the certificate. Where this can not be done without much inconvenience, gold may be remitted by mail free of postage.

SEC. 57. In case of deposits made in the deposit banks, a duplicate receipt should be taken, stating by whom the payment is made, and for what object. The particular invention should be referred to, to enable the applicant to recover back the twenty dollars, in case of the withdrawal of the petition. The certificate of deposit may be in the following form:

SEC. 58. *Bank of*

The Treasurer of the United States has credit at this office for dollars in specie, deposited by , of the town of , in the county of , and State of , the same being for a patent [or whatever the object may be] for a steam boiler.

SEC. 59. N. B. The Patent Office does not make original drawings to accompany applications for patents, and furnishes copies of the same only after the patent is completed. Draughtsmen in the city of Washington are always ready to make drawings, at the expense of the patentees.

On Recovering back Money paid for a Patent not taken out.

SEC. 60. When an applicant, who is a citizen, or a resident alien, relinquishes, or abandons, the application for a patent, he must petition the Commissioner of Patents, stating the abandonment, or withdrawal, of his application; in which case twenty dollars will be repaid. If this withdrawal be of a foreign patent, two-thirds of the fee paid is to be returned.

SEC. 61. In case of withdrawing a petition, the model deposited is by law retained.

SEC. 62. Whenever a patent is refused by the Commissioner on the ground that the alleged invention is not new, or interferes with an existing patent, or is not sufficiently useful and important, or in case of two, or more, interfering applications, the party, or parties, against whom the Commissioner has decided, can have remedy by an "appeal to the Chief Justice of the District Court of the United States for the District of Columbia, by giving notice thereof to the Commissioner, and filing in the Patent Office, within such time as the Commissioner shall appoint, his reasons of appeal specifically set forth in writing, and also paying into the Patent Office, to the credit of the patent fund, the sum of twenty-five dollars. And it shall be the duty of said Chief Justice, on petition, to hear and determine all such appeals, and to revise such decisions in a summary way, on the evidence produced before the Commissioner, at such early and convenient time as he may appoint, first notifying the Commissioner of the time and place

of hearing, whose duty it shall be to give notice thereof to all parties who appear to be interested therein, in such manner as said Judge shall prescribe. The Commissioner shall also lay before the said Judge all the original papers and evidence in the case, together with the grounds of his decision, fully set forth in writing, touching all the points involved by the reasons of appeal, to which the revision shall be confined. At the request of any party interested, or at the desire of the Judge, the Commissioner, and the Examiners in the Patent Office, may be examined, under oath, in explanation of the principles of the machine, or other thing for which a patent, in such case, is prayed for. And it shall be the duty of said Judge, after a hearing of any such case, to return all the papers to the Commissioner, with a certificate of his proceedings and decision, which shall be entered of record in the Patent Office; and such decision, so certified, shall govern the further proceedings of the Commissioner in such case: *Provided, however*, That no opinion, or decision, of the Judge, in any such case, shall preclude any person interested in favor, or against the validity, of any patent which has been, or may hereafter be, granted, from the right to contest the same in any judicial court, in any action in which its validity may come in question."

Remedy in Equity for Patentees.

SEC. 63. In cases where patents are refused for any reasons whatever, or when there shall be two interfering patents, remedy can be had from the decisions of the Commissioner of Patents, or from the Chief Justice of the United States Court for the District of Columbia, by bill in equity; and the Court having cognizance thereof, on notice to adverse parties (and when there shall be no adverse party, a copy of the bill shall be served upon the Commissioner of Patents, when the whole of the expenses of the proceedings shall be paid by the applicant, whether the final decision shall be in his favor, or otherwise,) and other due proceedings had, may adjudge and declare either the patents void in the whole, or in part, or inoperative, and invalid, in any particular part, or portion, of the United States, according to the interest which the parties to such suit may possess in the patent, or the inventions patented, and may also adjudge that such applicant is entitled, according to the principles and provisions of this act, to have and receive a patent for his invention, as specified in his claim, or for any part thereof, as the fact of priority of right, or invention, shall, in any such case, be made to appear. And such adjudication, if it be in favor of the right of such applicant, shall authorize the Commissioner to issue such patent, on his filing a copy of the adjudication, and otherwise complying with the requisitions of this act: *Provided, however*, That no such judgment, or adjudication, shall affect the rights of any person, except the parties to the action, and those deriving title from, or under, them subsequent to the rendition of such judgment.

On Filing the Specification and Drawings as a Caveat.

SEC. 64. "Whenever the applicant shall request it, the patent shall

take date from the time of filing the specification and drawings, not, however, exceeding six months prior to the actual issuing of the patent; and, on like request, and the payment of the duty herein required, by any applicant, his specification and drawings shall be filed in the secret archives of the office, until he shall furnish the model, and the patent be issued, not exceeding the term of one year; the applicant being entitled to notice of interfering applications."—Act of 1836, section 8.

SEC. 65. A full description of the invention is required, to enable the Commissioner of Patents to judge of interferences.

SEC. 66. All applications will be examined, and patents issued, in the order of time in which the proper documents are completed.

(To be Continued.)

Mechanics, Physics, and Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Mode of Coloring Daguerréotype Pictures. *By* CHARLES G. PAGE, M. D., *Prof. Chem., Columbia College, Washington, D. C.*

In the month of December, 1842, I instituted a course of experiments to determine the effects of oxidation upon the surface of Daguerréotype pictures, and arrived at some beautiful results in fixing, strengthening, and coloring these impressions. Numerous and arduous duties of a public nature have prevented me from investigating the subject as I wished, and I, therefore, present the facts for others to adopt as the basis of what promises to be a most interesting course of study and experiment.

First, a mode of fixing and strengthening pictures by oxidation:—The impression being obtained upon a highly polished plate, and made to receive, by galvanic agency, a very slight deposit of copper from the lupreous cyanide of potassa, (the deposit of copper being just enough to change the color of the plate in the slightest degree,) is washed very carefully with distilled water, and then heated over a spirit lamp until the light parts assume a pearly transparent appearance. The whitening and cleaning up of the picture, by this process, is far more beautiful than by the ordinary method of fixation by a deposit of gold. A small portrait fixed in this way, more than a year since, remains unchanged, and continues to be the admiration of persons interested in this art. One remarkable effect produced by this mode of fixing, is the great hardening of the surface, so that the impression is effaced with great difficulty. I have kept a small portrait thus treated, unsealed and uncovered for over a year, and have frequently exposed it in various ways, and rubbed it smartly with a tuft of cotton, without apparently injuring it; in fact, the oxidized surface is as little liable to change as the surface of gold, and is much harder. As copper assumes various colors, according to the depth of oxidation upon its surface, it follows that if a thicker coating than the first

mentioned, can be put upon the plate without impairing the impression, various colors may be obtained during the fixation. It is impossible for me to give any definite rules concerning this last process, but I will state, in a general way, that my best results were obtained by giving the plate such a coating of copper as to change the tone of the picture, that is, give it a coppery color, and then heating it over a spirit lamp until it assumes the color desired. I have now an exposed picture treated in this way at the same time with the two above mentioned, and it remains unchanged. It is of a beautiful green color, and the impression has not suffered in the least by the oxidation. Should this process be perfected, so as to render it generally available, it will be greatly superior to the present inartistical mode of stippling dry colors upon the impression; for the color here is due to the surface of the picture itself. For pure landscapes, it has a pleasing effect, and by adopting some of the recent inventions for stopping out the deposit of copper, the green color may be had whereever desired. In some pictures a curious variety of colors is obtained, owing to the varying thickness of the deposit of copper, which is governed by the thickness of the deposit of mercury forming the picture. In one instance a clear and beautiful ruby color was produced, limited in a well defined manner to the drapery, while all other parts were green. To succeed well in the first process, viz., that for fixation and the production of the pearly appearance, the impression should be carried as far as possible without solarization, the solution of the hyposulphite of soda should be pure and free from the traces of sulphur,* the plate should be carefully washed with distilled water, both before and after it receives the deposit of copper, in fact, the whole experiment should be neatly performed, to prevent what the French significantly call *taches* upon the plate, when the copper comes to be oxidized.

Description of an Improved Loom *for Weaving Horse-Hair. By* Mr. Henry Potts.

The object of Mr. Potts' improvement on the ordinary horse hair loom is to enable the weaver to dispense with the attendance of a server, whose business it is to place the ends of the horse hair in the hook, which draws them into the shed, where they are secured by the weaver striking up the batten with his left hand.

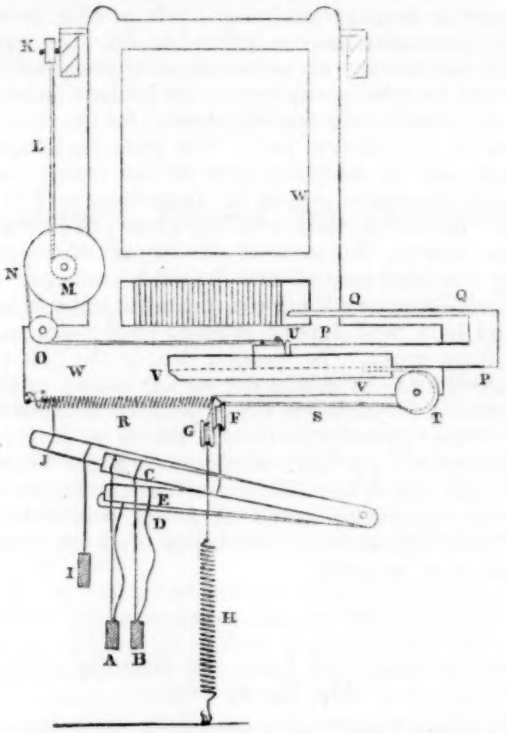
The parts of Mr. Potts' improved loom are so arranged, that the batten may be worked by the harness treadles, while an extra treadle is added for the purpose of passing the hook into the opening.

* The presence and deposit of sulphur, is a fault of most of the hyposulphite of soda of commerce, and it is the action of this sulphur upon the silver, that puzzles so many Daguerreotypers, by clouding, staining, and marking the plates in various ways. It may be obviated by repeatedly filtering the solution, or by keeping it in lightly corked bottles a long time before it is used.

In addition to the above I may state that exposure, of the coppered picture, to the vapor of hydrosulphuret of ammonia, produces sometimes a pleasing effect, but usually spoils the impression.

It is necessary that the weaver should have the use of both hands, for the purpose of taking up each shoot, doubling it, and laying it in the hook, the short end being held by the hand, while the hook carries, or guides, the other end to the opposite side of the opening, and finally leaves it lying straight across the threads of the warp.

In the accompanying view the framing which supports the several parts of the machine is purposely omitted.



The harness treadles, A and B, are attached by cords of equal length to a common lever C, and by the slack strings, as shown in the cut, to two other levers D and E, which, being tied to the lams, open the shed; while the lever C, draws back the batten by a cord passing over the pulley F, to the back of the batten; and, from the same point of fastening, another cord passes over the pulley G, in front of the batten to the helical spring H, which is attached to the floor, the object of which spring is to pull the batten forward; thus, when either of the treadles, A, or B, is down, the shed is open, and the batten held back; the treadle I, being then depressed, draws down the fourth cross lever J, which is connected by a cord with an equal lever K, pulling its back end down, while its front end rises with the string L, pulling round the small pulley M, which is fixed to the hinder part of the larger pulley N, to increase the motion, a cord

from which passes by the pulley to the near end of the slide P, and pulls it across the batten. The slide P, conveys the hook Q, at sufficient height to enter the shed, so as to pass through it, when the hair, being laid on to the hook, the treadle I, is released. The hook then flies back, its slide P, being drawn laterally by the spring R, and string S, which, after passing partly round the pulley T, is fixed to the under part of the slide. The slide moves freely in a trough V V, under the staple U, the object of which staple is to keep it in its place on the batten W W.

The hook Q Q, as shown in the cut, moves as much more than the treadle I, as the pulley N, is larger than the pulley M.

Trans. Soc. Arts, &c.

Description of an Improved method of Casting Screws. By Mr. William Bowser.

The difficulty of casting square threaded screws by the ordinary method, is owing to the nature of the spiral curve of the thread, which, presenting its angle of inclination parallel with the axis in opposite directions on each side thereof, prevents the possibility of removing the pattern without displacing some of the sand. To remedy this defect, Mr. W. Bowser has contrived a plan by which the patterns of square threaded screws may be withdrawn from the sand, and still leave perfect impressions for casting.

Instead of using only two flasks in casting any particular pattern, Mr. Bowser forms the mould for the screw in three flasks, two of which contain the upper and lower halves of the mould for the body of the screw, and the third one that for the mould of the head.

A metal plate of size sufficient to cover the end of the two long flasks when placed together, is attached to them, and has in its centre a screw nut which holds the pattern screw in its right position in the sand, at the division of the two halves, to form the required mould.

When the pattern of the body of the screw is to be removed from the sand, a key is introduced into the end of the pattern which passes through the nut, by turning which key the pattern is screwed out of the mould; the nut, which is firmly secured to the plate, affording the necessary resistance.

The plate and nut are then removed, and the third flask, containing that portion of the mould in which the head of the screw is to be cast, is joined to the two long flasks, when the whole is ready for casting.

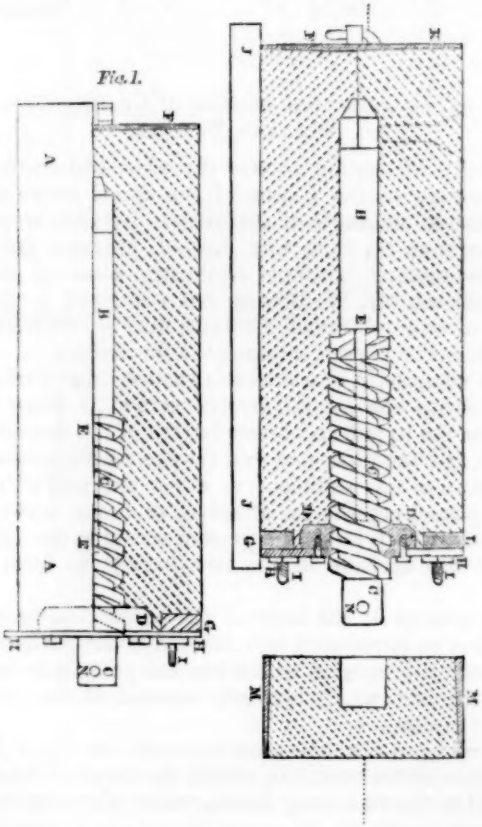
Figs. 1 and 2, exhibit sections of the flasks and screw in the different stages of the process.

A A, fig. 1, is a board prepared to receive half of the pattern screw, by having a hollow formed in it, so that the remaining half projects above the top of the board; B, C C, and D, are the three portions of the pattern.

The portion B, is furnished with a pin E E, which passes into a

cylindrical hole in the screw portion C, and serves to guide the pattern when being screwed out of the sand. The part D, has a hole properly cut to allow of a passage for the pattern to be removed. F G, is part of one of the long flasks shown in section, and placed on the board A A. In the end G, is a semi-circular aperture sufficiently large to allow of the sand being pressed in round the collar D. A metal plate H H, is then screwed to the pattern collar D, and to the flask F G, by two screws I I. Sand is next filled into the flask and rammed solid to the top, as shown by the dotted sloping lines.

Fig. 2.



A second board J J, fig. 2, is now fixed to the top of the flask F G, and the whole being turned over, the board J J, becomes the lowest. The first board A A, is then removed, which leaves half the pattern above the sand. The first half of the mould is then made good if any defects are found in it; and the flask K L, is then placed over and secured to the flask F, and also to the plate H H. Sand is then filled into the top of this flask, and rammed solid as before, which

completes the impression of the body of the screw. The plate H, is next removed in order to attach to the two long flasks, by means of the screws I I, the end flask M M, which is filled with sand to take the impression of the head. This done, the end flask M M, is removed, and the plate H H, is again secured to the flasks F G, and K L, and also to the collar D.

The screw portion of the pattern is now withdrawn by applying a key to the aperture N, and turning the pattern round till it is removed entirely from the sand.

In order to remove the plain portion of the pattern B, the upper and lower flasks are separated from each other, and then all the flasks being once more united, a proper opening is made in the sand, and the metal poured in to obtain the required cast.

Ibid.

Description of a Hook for connecting Catgut Lines used in Machinery. By Mr. Samuel Nicholls.

The ordinary method of connecting the ends of catgut, when used as an endless line for machinery, is, by means of a steel hook and eye, the hollow stem of each being screw-tapped, for the purpose of holding the catgut.

Mr. Nicholls substitutes, for the above arrangement, a double hook C C, and two eyes A B. The catgut is secured to each of the eyes in the ordinary way, and the hook is an independent piece, and somewhat similar in shape to the letter S, except that each hook is at right angles to the other.

The advantages of this arrangement are, that the hook is less liable to jump on the pulley, it affords more play for the twist of the band, and the openings of the hooks being made very small, the eyes are not liable to be unhooked.

Ibid.

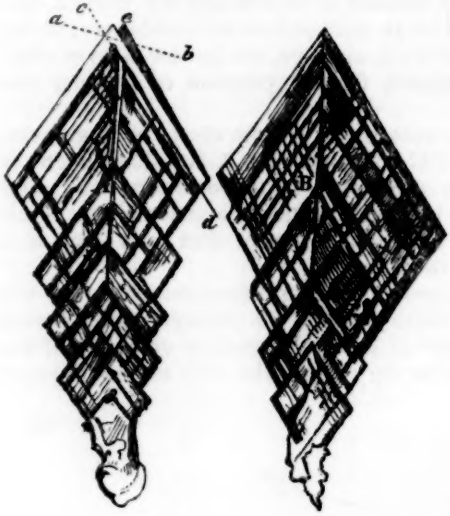
On the change of color in the Biniodide of Mercury. By Robert Warington, Esq.

It is well known that when a solution of the iodide of potassium is added to a solution of the bichloride, or pernitrate, of mercury, a yellow precipitate, passing rapidly to a scarlet, is formed; this is the biniodide of mercury. It is soluble in an excess of either of the agents employed for its production, and if this act of solution be assisted by heat, the biniodide may be obtained, as the solution cools, in fine scarlet crystals, having the form of the octohedron with the square base, or its modifications.

If this precipitated biniodide, in the dry state, be subjected to the action of heat, it becomes of a bright pale yellow color, fuses into a deep amber-colored fluid, and gives off a vapor which condenses in the form of rhombic plates of the same bright yellow; these crystals, by any mechanical disturbance, arising from the unequal contraction of their molecules in cooling, from varying thickness in different parts of the same crystal, or from partial disintegration, return again to the original scarlet color of the precipitate, the change commencing, in the latter case, from the point ruptured, and spreading over the whole of the crystaline mass; they may, however, be frequently preserved in the yellow state for a great length of time, if sublimed slowly, and not exposed to the contact of other substances, which is readily effected by conducting the sublimation in closed vessels, and allowing the crystals to remain in them undisturbed.

The resumption of the scarlet color has been attributed to an alteration in the molecular arrangement of the crystals, and it was with the view of clearly ascertaining this point that the following microscopic investigations were undertaken.

Fig. 1.



When a quantity of the precipitated biniodide is sublimed, the resulting crystals are very complicated in their structure, consisting of a number of rhombic plates, of varying size, superposed, sometimes overlapping each other, and causing considerable variableness in their thickness, but generally leaving the extreme angle, and the two lateral edges clear and well defined; the annexed sketch, taken by the camera lucida, from the field of view of the microscope, will give a better idea of their character. The length of these crystals was about .015 of an inch. On cooling, the first change that is observed is usually a scarlet marking, commencing at the extreme

angle, and extending gradually inwards, always retaining a perfectly well defined line in its progress; when this change has reached as far as the line *a b*, fig. 1, the scarlet line will suddenly shoot along one of the lateral edges, as shown at *c d*, and instantly the whole mass is converted, in a most rapid and confused manner, which the eye in vain endeavors to follow, to the scarlet color, the crystal being frequently, if detached, twisted and contorted during the transition.

In order to obtain these crystals in a more defined and clearly developed form, a small glass cell was constructed of two slips of window glass, leaving a space of about the thickness of cartridge paper between the upper and under plates, in which the sublimations could be readily conducted, and the whole of the subsequent changes at once submitted to the microscope; by this means beautifully well defined and perfect crystals were obtained having the form of right rhombic prisms, as in the accompanying outline, fig. 2, *a* and *b*. The following interesting phenomena were then observed: a defined scarlet line of varying breadth would shoot across the crystal, as at 1, *c*, *d*, *e*, *f*, fig. 2, and then gradually spread throughout the whole of its structure, keeping a straight and well defined line in its onward progress, until the whole had undergone the change of color. Nos. 2, 3, 4, 5, in *e*, and No. 2, in *f*, are the stages which the transition had reached at intervals of observation; in many cases, after the crystal has undergone this metamorphosis, two angles can be distinctly seen, as at *e*, fig. 1, and at times two edges are visible, as at *c* 6, and *d* 6, fig. 2. This observation must, of course, depend entirely on the position of the crystal to the eye of the observer.

Fig. 2.

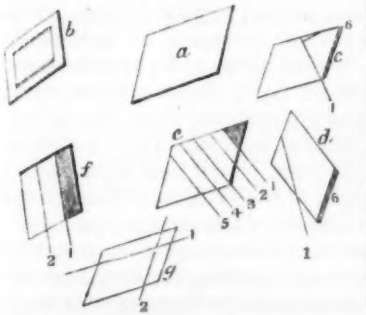
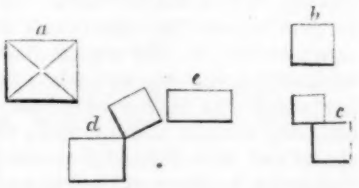


Fig. 3.



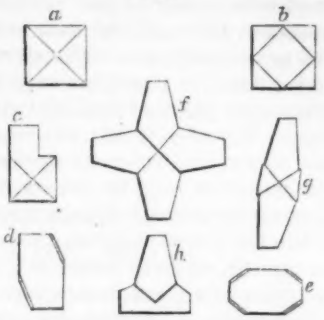
These phenomena prove, I consider, in the most perfect manner, that the change in the color of this compound arises from the plates of the crystal having been separated from each other, by the means alluded to, in the direction of their cleavages; and in further confirmation of this view, the laminæ, so separated, may, by the sudden application of heat, be again fused together, and the yellow color reproduced without materially altering the dimensions of the crystal, a slight rounding of the edges from partial sublimation being the only other concomitant.

When the temperature is raised slowly, and the sublimation conducted with great care, a very large proportion of red crystals, having a totally different form, are obtained, the octahedron with the square base, as shown in fig. 3, *a*, *b*, *c*, *d*, *e*. If, however, the heat is quickly raised, the whole mass of the sublimed crystals are yellow, and of the rhombic form. It is evident, from these facts, that the biniodide of mercury has two vapors which are given off at different temperatures, and also that it is dimorphous, which facts have been substantiated by some experiments of M. Frankenheim, who has carefully examined this part of the subject.

From the circumstance that the first effect which occurs in the process for preparing this iodide, by precipitation, is the production of a yellow powder which passes rapidly through the orange color to a scarlet, I was induced to submit this phenomenon also to the test of microscopic examination, and with this valuable instrument of research, results were exhibited which could not have been anticipated. As I expected, the precipitate was in small crystaline grains, and the first step of the investigation was to effect its formation in the field of view of the microscope, so as to observe, directly as they occurred, the transitions of color which have been alluded to, and this was effected by the following means:—A slip of common window glass, about three inches long by one and a half wide, and having a very narrow slip attached on one of its edges, so as to act as a ledge, was taken, and a drop of the salt of mercury employed, placed on it; this was then covered with a small piece of extremely thin glass, about one inch long by half an inch wide, and the whole carefully adjusted to a focus in the field of the instrument; the iodide of potassium was then introduced by capillary attraction between the glasses. The instant the solutions came in contact, a myriad of pale yellow crystals, having the same rhombic form as those obtained by sublimation, formed in a curved line across the field of view, and extended slowly downwards; by the strong transmitted light, these minute crystals appeared colorless; but when viewed by reflected light, the pale yellow color was readily apparent. After a short interval a very extraordinary change commenced; the crystals, which had been perfectly sharp and well defined, became ragged at their edges, as though some dissolving action were going on, gradually decreased in size, and at last disappeared altogether; but as this act of solution progressed, numbers of red crystals made their appearance, forming across the field, and following, at a regular distance, the yellow crystals as they disappeared, and occupying their place. These red crystals, which appear to be formed by the disintegration through the medium of solution, if I may be allowed the expression, from those first produced, had the form of the octahedron with the square base, exactly similar to those procured by careful sublimation at a low heat, only modified in the most beautiful manner. Some few of these are sketched in the forms *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, fig. 4. When either the salt of mercury, or the iodide of potassium, employed in the production of the biniodide of mercury was in excess, another curious act of disintegra-

tion took place; the red crystals in fig. 4, were slowly dissolved, a property mentioned in the first part of this paper, the first act of solution commencing apparently by the disjunction of the crystals *a, b, c, f, g, h,* at the lines of marking, these lines being at first bright red, and gradually deepening in color when the act of solution commenced, and at last perfect separation taking place, so that the light could be seen between the compartments. At times the field would become dry from evaporation, and some of the yellow rhombic crystals which had not been dissolved, prior to the formation of the octahedra with the square base, were observed with scarlet lines on them similar to the first act of transition in the sublimed crystals, as shown at *g* 1 and 2, in fig. 2.

Fig. 4.



By polarized light the appearances now described were beautiful beyond all description, the yellow crystals presenting the most superb and brilliant colors, varying in hue with the varied thickness of the crystaline plate, and in the dark field having the appearance of the most splendid gems the imagination can conceive: the red crystals do not appear to be affected by polarized light, so far as the display of color is concerned.

The magnifying powers used in these investigations, were, for the experiments on the sublimed crystals, 200 times linear measurement, or diameters; in the precipitated compound, 620 diameters.

Mem. Chem. Soc., Lond.

On the Progress made in the Application of Electricity as a Motive Power. By W. R. Grove, Esq.; *read before the Royal Institution, February* 9, 1844.

The subjects of Mr. Grove's communication were, first, a brief summary of the laws of the electro-magnetic force; second, a description of the chief modifications of the engines to which that force has hitherto been applied; third, the commercial statistics of its application; fourth, the purposes for which this power is available. In dealing with the first of these subjects, Mr. Grove exhibited, by many illustrative and successful experiments, the well known re-actions of iron and other metals on each other, when exposed to the influence of an electric current. The actual application of these familiar phenomena, was then shown in the working models of several machines, which were set in action by the nitric acid (or Grove's) battery, invented by Mr. Grove, and described by him four years ago at the Royal Institution. These machines may be divided into three classes, first, those acting by the immediate deflecting force, as shown in the

galvanometer, Barlow's wheel, &c.; secondly, those on what is called the suspension principle. In these, two powerful electro-magnets are fixed contiguous to the periphery of a wheel, and in the line of its diameter, plates of soft iron being fastened on this pheriphery at short and equal intervals. The electro-magnets are so arranged as to lose their attractive power as soon as they have drawn through a given space each plate of iron, necessarily presented to them by the revolution of the wheel, but are immediately afterwards re-invested with this power, in order to operate on the next plate. By these means the wheel is kept in constant rotation on its axis. The remaining class of electrically driven machines are applications of the principle of Ritchie's revolving magnet. In these, an electro-magnet, balanced on a pivot, so as to rotate in a horizontal plane, is arranged between the poles of a permanent magnet. Hence, the alternate attractions of the opposite magnetic poles, combined with its own momentum, cause the electro-magnet to continue rapidly revolving. Having noticed machines, on these various principles, by H. Fox Talbot, Esq., Mr. Hill, of Swansea, and Professor Wheatstone, Mr. Grove proceeded to his third subject, the commercial statistics of electro-magnetic power. It appears, by the experiments of Dr. Botto, that the consumption of 45 lbs. of zinc will produce an effect equivalent to a single horse power for twenty-four hours. The cost of the metal, at 3*d.* the pound, would amount to 11*s.* 3*d.* About 50½ lbs. of the nitric acid of commerce would be required to dissolve the metal in the most economical and effective manner. The charge of this, at 6*d.* the pound, would be 1*l.* 5*s.* 6*d.* The whole expense, therefore, of obtaining the effect of a one horse power by an electro-motive apparatus, would be 1*l.* 16*s.* 9*d.* In this calculation, the cost of the requisite sulphuric acid is assumed to be fully covered by the value of the salts of zinc produced in the operation. The same amount of power produced by a steam engine would not cost more than a few shillings. Mr. Grove explained that this comparative costliness of the electro-magnetic machines resulted from the sources of their force, zinc and acid being manufactured, and, consequently, costly articles; whereas, coal and water, the elements of the steam engine's force, were raw materials, supplied at once from the earth. Mr Grove took this occasion to observe, that the experiments of Botto, just alluded to, were made with his (Grove's) battery; and that upon the cost of the constituents of this, the calculations were founded. At first sight, this battery would appear a dear form, from the expense of the nitric acid; but a little consideration proves the contrary of this. Compare it, for example, with a battery merely charged with dilute sulphuric acid, the cheapest possible electrolyte, to perform an equivalent of work, as the decomposition of a given quantity of water, a series of three cells of the ordinary battery is necessary; hence the consumption of three equivalents of zinc, and three of sulphuric acid. But the intensity of the Grove's battery is such, that the same resistance can be overcome by one cell, consuming only one equivalent of zinc, one of sulphuric acid, and one-third of nitric, there being in this acid three available equivalents of oxygen. Independently of this smaller consumption, Grove's

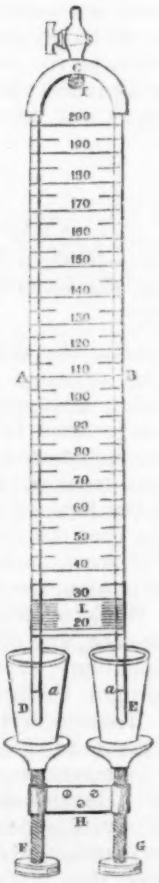
battery has the advantage of occupying only one-sixteenth of the space of the other constructions. In concluding his communication, Mr. Grove mentioned the two well known applications of electric power—the electric telegraph, and the electric clock. To neither of these can steam, or, indeed, any known force, be so applicable as that which travels with a greater velocity than light itself.

London Athenæum.

Description of an Instrument for Ascertaining the Specific Gravity of Fluids. By John Ham, Esq., Civ. Eng.

I beg to forward, for insertion in your highly popular publication, the drawing of an apparatus for readily ascertaining the specific gravity of fluids, which I devised some months since, and find extremely useful in practice.

By having the scale minutely divided, or adapting to it a vernier, it is susceptible of a high degree of accuracy, and for all ordinary fluids, is infinitely superior to the gravity bottle and balance, and in many instances preferable to the common hydrometers, especially in commercial transactions, where rapidity and accuracy are essential points.



A and B, are two glass tubes, from ¼ to ⅜ths of an inch bore, and of any convenient length; about 2 feet will be found sufficient for usual purposes; C, a connecting brass tube and stop-cock; D and E, two glasses, one for distilled water, the other for the liquid whose specific gravity is required; F and G, two milled headed screws, carrying each a stand for one of the glasses; H, a bracket with two nuts for supporting the screws and stands, F G; I I, the scale, divided into 200, or 2000, equal parts, or degrees.

The mode of using it is simply this: Pour distilled water into one of the glasses, and the liquid to be tried, into the other, both at 60°, or any

moderate *uniform* temperature. Exhaust the air in the tubes—either by means of a syringe, or the mouth being applied at the stop-cock C—until the lightest fluid is nearly at the top of one of the tubes; then bring the surfaces of the two fluids, in the glasses E and E, on a level with the marks *a a*, on the tubes, by means of the screws, raising, or lowering, the stands as required; the heights of the fluids in their respective tubes will immediately give their relative gravities, convertible into water at 1000, by simple proportion.

Lond. Mech. Mag.

[NOTE.—We insert the above in the hope that it may be found of interest to some of our readers, as well as to protest against the constant reproduction of *worn-out* novelties in the journals. The machine here described forms part of the apparatus of almost every physical lecture-room. Among the Apparatus of the University of Pennsylvania, is a very beautiful instrument of this kind, made by Lerebours, of Paris, and so entirely like the drawing, that it might be supposed to be the identical model. This has been in the possession of the University for, at least, ten years; so that the thing is, or ought to be, as well known in Europe, as it is here.

COM. PUB.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Hydraulics.—General Sketch of a Theory of the Contraction of Veins in Water discharged from Orifices in thin Plane Walls. By M. BÆYER.

In comparing the different experiments upon the flow of water from vertical openings in thin plane walls, we are struck by the great variation undergone by the coefficient by which, in each case the theoretic formula for the discharge must be multiplied. On examining the facts more strictly, we find two sorts of distinct variations, of which one depends solely upon the amount of the charge, and the other upon the form of the orifice. The existence of the first is a certain sign that the formula used does not accord with the experiments. The second proves that the water of the reservoir is subject to a law of motion, the effect of which is modified by the form of the opening. While reflecting upon these difficulties, I was struck by a very simple idea, and one which deserved a rigorous investigation. This investigation is the subject of my memoir. To present the results in a proper light, I will here give, in a concise manner, the sketch of my work. I assume hypothetically, that the molecules of water in the reservoir, move towards the centre of the orifice, with velocities which are inversely proportional to the square of their distances from that centre. Hence it follows, that molecules equi-distant from that centre will have the same velocity, and are situated upon the circumference of a hemisphere described from that centre with a radius equal to, or greater, than that of the orifice. As soon as the molecules have arrived at the hemisphere described with the radius of the orifice itself, their velocity is decomposed into two others, of which one is

parallel to the axis of the orifice, and the other perpendicular to this axis. The first gives the velocity perpendicular to the plane of the orifice, and the other represents the velocity of contraction. But in order to determine, in conformity with the hypothesis adopted, both of these velocities, it is required to find the mean distance from the plane of the orifice, of the particles in the section of a hemisphere passing through its axis; that is, the mean distance of the molecules upon the periphery of a semi-circle of the same diameter. We arrive, by this means, for circular orifices, at results conformable to those of the experiments of Bossut, Poleni, Eytelwein, &c. By this examination we find, for the orifices in question, the variation in the discharge dependent upon the form of the orifice; nothing more is wanting than to seek for that which depends upon the charge, or to determine the true velocity of discharge, which is done by the known methods. Thus, in determining the coefficient of contraction (k) of vertical rectangular orifices, we arrive at the general formula,

$$k = \frac{l}{b}.0.1140449\,\frac{(m+\sqrt{\pi})^{\frac{3}{2}} - \left[m+\left(1-\frac{b}{l}\right)\sqrt{\pi}\right]^{\frac{3}{2}}}{\sqrt{m+1}\left[\frac{1}{2} - \frac{1}{64(m+1)} - \ldots\right]}$$

Where l, is the base of the rectangle, b, its height, π, the ratio of the circumference of a circle to its diameter; m, is determined by means of the equation $m = \frac{(H-a-l)\sqrt{\pi}}{l}$, where H is the charge above the lower edge of the rectangular orifice, a, is the height of a column of water equivalent to the difference of the atmospheric pressure upon the surface of the water in the reservoir, and upon the centre of the orifice. This value taken for the following table is equal to 0.0020 metre.

In order to show the correspondence of the formula with observations, I have compared it with the admirable experiments made by M. Poncelet, et Lesbros, at Metz, in 1828; calculating only the coefficients of the first experiments in the six tables, from No. 4 to No. 9, I get

Number of the Tables.	Charge above the lower edge. H.	Sides of the Rectangular Orifice.		Value of the Coefficient, k.		Difference.
		Ver. side. b.	Hor. side l.	Observed.	Calcul'ed.	
	Metres.	Metres.	Metres.	Metres.	Metres.	
4	1.5720	0.20	0.20	0.6026	0.6034	— 0.0008
5	1.6054	0.10		0.6111	0.6135	— 0.0024
6	1.7151	0.05		0.6175	0.6180	— 0.0005
7	1.3960	0.03		0.6229	0.6225	+ 0.0004
8	1.4102	0.02		0.6217	0.6234	— 0.0017
9	1.4070	0.01		0.6204	0.6246	— 0.0042

These differences do not exceed those which the results of experiment several times repeated, show. The calculated values of k, are

found a little too large, because all the other small corrections have been neglected, such as the friction on the edges of the orifice, the temperature, the resistance of the air, &c.

In the memoir I have employed an approximative formula, which differs very little from the exact value, and which is formed by supposing that the velocities, in rectangular orifices, are as the square roots of the charges above their centres.

All these formulæ, however, suppose that the level in the reservoir remains constant, which is not the case in practice, except when the charge is ten, or twelve, times greater than the radius of the orifice. In small charges there is a depression of the level above the orifice, for which allowance must be made, in order to obtain exact results; for this reason it is necessary to multiply all the formula by a factor which depends upon the depression; by this means I obtain equations which are applicable, at the same time, both to great and small charges, and even to overfalls.

Finally, the different forms of the veins of water are determined by means of the theorum mentioned above, that the force of contraction is proportional to the radius of the orifice. Hence it follows that the contraction in the diagonal sections of a square orifice is greater than that in the sections passing through the centres of parallel sides, and as the contraction may be regarded as a force acting perpendicularly upon the axis of the vein, it follows that the particles of water in the larger sections approach the axis, whilst the particles, in the smaller sections, are farther from it, which explains the forms found by experiment.—*Comptes Rendus, 15th January*, 1844.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Report upon a Note relative to the Flexure of Beams Loaded in a Vertical Position; presented June 20th, 1842. *By* M. E. LAMARLE. *Committee, Poncelet and Lionville.*

In this note M. Lemarle has chiefly proposed to establish the following principles:—

1. The loads, which beams, loaded vertically, can support without permanent alteration, are independent of their lengths, and simply proportional to their sections, so long as the ratio of their lengths to the least dimension of their transverse section does not reach a certain limit.

2. Beyond that limit, and in all cases of practical application, the maximum load may reach, but can never exceed, the pressure corresponding to the initial flexure.

M. Lamarle also shows that (the pieces being supposed prismatic,) it is sufficient to know the greatest change in length compatible with the preservation of elasticity, in order to determine numerically the limit alluded to. He remarks beside that the results furnished, by calculation, accord with the facts generally observed, and that they imply the consequences announced by M. Duleau, in the following terms: "A rectangular bar pressed vertically, resists until the com-

pressing weight attains the value, $Q = \frac{\pi^2 c}{4a^2}$. This weight causes the piece to assume a curvature in the direction of its smallest dimension, and it at once folds together." The deductions of the author rest essentially upon the analysis given by M. Lagrange, for the problem of the flexure of pieces loaded vertically, but by imposing the condition of not surpassing the force capable of producing a permanent alteration, and by expressing this condition numerically, M. Lamarle has introduced into the question an element of which advantage had not yet been taken to solve it practically. The introduction of this element fixes the degree of convergence of the series which are obtained, and permits the deduction from the general solution, of rules valuable to the builder.

We know, and Lagrange has proved, that the flexure of pieces pressed vertically, becomes possible only when the pressure has obtained a certain minimum value. If the pieces are prismatic, the load corresponding to the initial flexure, increases in the inverse ratio of the squares of their lengths. The contractions which it produces, independent of all flexure, are, therefore, more considerable in reference to the unit of length, in proportion as the pieces are stouter, and we may conceive that for a given cross section there exists always a length below which there is already an alteration of elasticity, even when the load is too small to cause a commencement of flexure. Hence the first principle announced by M. Lamarle.

Let us now consider the case of flexure, and let us suppose the ratio of the length to the smallest dimension of the cross section to be so great, that flexure may commence before a permanent alteration has taken place. In this case the strain *due to the effect of flexure alone*, increases as the versed sine; and M. Lamarle shows that an almost imperceptible increase of the pressure corresponding to the initial flexure, is sufficient to cause an instant alteration of the elasticity. Hence the second principle of the author, not absolute, but sufficiently general to include all the cases which might escape the first, under the circumstances usual in practical applications.

These two principles taken together, offer a satisfactory solution to the question of beams loaded vertically.—*Comptes Rendus, 15th January*, 1844.

On Madder. By M. Girardin, *Prof. Prac. Chem. at the Municipal School of Rouen.*

In commerce the name of *Lizari* has for a long time been restricted to the entire roots of the madder, while that of *Madder* is applied to the pulverized roots.

The Lizaris are very little employed for the purposes of dyeing, and there is hardly any but the Lazari of Avignon, which is met with in the markets of France. The Lizari of Cyprus is actually of rare occurrence; that of Alsatia is never met with.

The powders called *madders* are distinguished according to their

origin, into *Dutch Madder, Alsatian Madder,* and *Madder of Avignon,* or of the *Comtat.*

Up to the present time no one of the numerous works which have been written upon this subject, no work of Materia Medica, or of applied botany, has given the history of these powders, nor the peculiar characters of each variety; I shall endeavor to supply this want by giving a detailed description of the three kinds of madder met with in commerce. My situation has enabled me to make a particular study of this important tinctorial product; and the following remarks are the result of many and various observations:—

I.—*Dutch Madder.*

The Dutch madder, which was formerly extensively employed in France, has almost entirely disappeared from our markets, from the heavy duty which the government purposely put upon it, in order to maintain and encourage the cultivation of that of Alsatia, and of the Comtat. This madder possessed a well deserved reputation, and there is no doubt but that it would again be generally used, if the duty, which is equivalent to a prohibition, were to be reduced. The following are its distinctive characters:—Its odor is strong and nauseous; its flavor is sweet, with a mixture of bitterness; its color varies according to the marks, and passes from a brown-red to an orange-red.*

In general its powder is stringy *(en paille)* that is to say, its state of division is sufficiently large to exhibit the structure of the root. It is coarser than the powder of the other kinds of madder, which might be attributed to negligence, since frequently portions of Lizari are met with which have not yielded to the grindstone. This coarse state of comminution, however, is no defect, since it prevents fraud. This powder appears greasy to the touch. Exposed to the action of the atmosphere, it readily absorbs moisture, and when, for the sake of ascertaining its quality, it is exposed to a moist air, its orange-red changes to a bright red, of a rich depth of color. The Dutch madder *works* more than the others, according to the commercial term, *i. e.* it presents more decided modifications of color by exposure to moist air.

Dutch madder is *stripped,* or *not stripped.* In the first case, the roots have been freed from their epidermis, which gives greater brightness to the powder; in the second, they have been triturated without undergoing this operation, when the powder is of a more sombre color. This madder cannot be used while fresh; it must be a year in the cask, at least. After three years it is in full vigor.

The *pale* powder, or of a yellow aspect the first year, soon undergoes fermentation with age; the divided parts then unite with each other, agglomerate, and increase in volume to such a degree, that,

* The red-brown tint is only applicable to the *mulle* madder of each kind. The term *mulle,* or *billon,* is applied to the inferior quality of madder. It is a mixture of the smallest roots, of the fibres, and of the epidermis of the large roots, of earth, and of the bran, or refuse, of the sieves.

after several years, the dilatation is so great that the bottoms of the casks present a very marked convex form. The madder is then so hard, that in order to take it out of the cask, a mallet, or chisel, must be used. This madder ferments more than the others.

It keeps several years after having attained its greatest tinctorial power, (about three years) after which the layers which line the sides of the casks, begin to lose their brightness; the madder assumes a pale brown color, and it enters into decomposition. The progress of this is slow but certain; it subsequently becomes quite extinct, and the madder has a brown-red color.

In its decomposition it may still be used for brown grounds, or colors; but when age has destroyed all the coloring principle, it can only serve as *mulle.*

The marks current in our markets are

Mulle O, ...	or	Mulle.
Superfine, ...		Fine grappe.
Not stripped, or stripped, .		Superfine grappe.

This word *grappe* (bunch) is employed when age has given consistence to the powder. The term *grappe* is used to designate its state of agglomeration.

This kind of madder formerly came from Holland in oaken casks of the weight of 600 kilogrammes.

II.—*Alsatian Madder.*

This madder, which has replaced the Dutch in our manufactories, although it does not possess all its qualities, has the following characters:—

The smell is less decided, more penetrating than that of the preceding; taste less sweet, equally bitter; color brown to bright yellow, according to the mark; state of division, coarse. It easily absorbs moisture from the atmosphere; by long exposure it changes from yellow to a dark red; in use, however, it inclines more to yellow.

As is the case with the Dutch madder, it is not employed while fresh; it is in full vigor when two years old. It deteriorates sooner than the former; its fermentation is less decided; it grows very hard, however, in the casks, coheres to the very centre, and there is the same difficulty to extract it. The progress of decomposition is the same; the madder which has undergone this process can only be used for dark tints.

The Alsatian madder is never known by the denominations of *stripped,* or *not stripped,* although the operation of *stripping* takes place. The marks alone distinguish the varieties. The marks known in our markets are

O, Mulle.	**SF, Superfine.**
MF, Mi fine.	**SFF, Superfine fine.**
FF, Fine fine.	

The most generally used is **FF.**

SFF, is nearly an exception to the method employed by the Alsatians in grinding, who are strict enough in their marks to be unwil

ling to prepare a very fine quality, which would be to the injury of the preceding.

The madder of Alsatia is packed in oaken casks, or hogsheads, of 600 kilogrammes, in half hogsheads of 300 kilogrammes, in quarters of 150 kilogrammes, and in barrels of 100 kilogrammes. All these hogsheads are similar in form, and only differ in size.

It is at Strasburg, Hagenau, and Geisselbrunn, that the so called Alsatian madder is manufactured.

III.—*Madder of Avignon.*

The madder of Avignon is most generally used at the present time, and even preferred to the other kinds, because the dyer and cotton printer find it easier, by using it, to vary the reds according to wish. It is especially since the peace of 1815, that the use of this madder has greatly increased.

Of all the kinds of madder this is the sort which has undergone the most modification; I may say, almost the only kind in which variations have been made in the marks, and in the quality. In Holland and in Alsatia, the quality specified is generally conformable to the mark. In Avignon, on the contrary, each manufacturer has a mark to designate its quality; and the mark SFF, which with one is beautiful, is but middling with another. The result is, that the trader cannot trust to the mark alone, which presents a different tint in each manufactory. The madder of Avignon, therefore, can only be bought after having been spread out to view upon linen.

The characters of this powder are, odor agreeable, slightly penetrating; taste sweetish bitter; color either rose, bright-red, or brown-red, according to the roots employed in the preparation, and to the degree of mixture; state of division very fine; powder dry to the touch.

When submitted to the action of the atmosphere, it absorbs moisture less readily than the other species; however, it does not work less, and subsequently affords a pale, or very dark, red, according to whether the powder operated on was *rosy*, or *palus*.

In Avignon they are not acquainted with the terms ***stripped***, or *not **stripped**, (robée ou non robée.)* There the word *épuration* is used. A madder is purified from 3, 5, 7, or 10, per cent., and even as high as 15 per cent. This mode of expression is pure quackery, for how is a root to be purified except by depriving it of its epidermis, and how can we suppose that the root may contain at will so much more, or less, of it, as to require that the purification should sometimes be carried to 15 per cent.? We should have to suppose that the weight of the epidermis was to that of the root as 1:7, 10 or 15, which is not the case.

The best madder is made with the roots of the Palus. In Avignon the name of ***Palus*** is given to some tracts of land anciently covered with marshes; these lands, enriched by animal and vegetable remains, are eminently suited for the cultivation of the madder, and the roots they produce are almost all ***red***, whilst other kinds of soils produce rose colored roots.

The powder from the Palus madder is of a dull and rather unsightly red, but on drying it becomes blood-red, which may be varied at pleasure. A small quantity goes much farther than a larger quantity of the *rose colored* root.

The *rose colored* madder is made with the so called *rosy* Lizaris. The powder is of a bright red, bordering a little upon yellow.

The madder, which is half *palus*, half *rosy*, forms a brilliant powder, which is well received in the market, and which affords very satisfactory results in dyeing. The brilliancy of the *rosy* madder mingling with the rich depth of the palus, produces a most beautiful red.

The madder of Avignon may be used immediately on leaving the mills; but the powder which has been preserved in casks for a year is decidedly preferable. It keeps well, and undergoes little, or no, fermentation in the casks; it does not cohere in a mass; after several years, however, it is decomposed with nearly the same symptoms as the other kinds: it is still used in this state. The small degree of fermentation evinced by this madder, arises from its containing much less mucilaginous, saccharine, and bitter substances, than the Dutch and Alsatian madder, for it is certain that the acid fermentation which is so energetically developed in the latter, must be attributed to those substances.

Although pressed with great force into the casks, the madder retains a certain quantity of air between its particles, which, in time, acts upon the whole mass, and gives it a uniform color, by oxidizing the primitive yellow coloring principle, and changing it into a red principle. This theory, advanced by M. Decaisne, very well explains why the madder powders are improved in quality by being preserved for a certain time in the casks.*

The drying of the roots in the stove has great influence on the tint of the madder of Avignon. If dried at too high a temperature, the powder is dull, without, however, losing in quality.

At first only two kinds of Avignon madder were known, the *yellow madder*, and the *red madder*. The first has since disappeared, and the *rosy madder* is now substituted for it.

As to the marks, it is difficult to give positive information on the subject, especially since quackery has endeavored to deceive by extraordinary names. Originally only the following marks were known:

Mulle.
FF, Fine fine.
SF, Superfine,
SFF, Superfine fine.

These marks were put upon the casks without other designations. The tint alone decided to what sort of root the powder belonged. At present the madders are either—

Palus, or
Rosy, or
Half Palus, half rosy.

* Anatomical and Physiological Researches concerning the Madder. By M. Decaisne; 1 vol. 4to.: Brussels, 1837.

When it is wished to denote that a madder is all *Palus*, a P is added to the mark. The following are the actual marks:—

Mulle, without distinctive marks.

FF	To each of these marks the letter
SFF	P is added for Palus,
SFFF	R for Rosy,
EXTF	PP for Pure Palus,
EXTSF	RPP for Pure Red Palus,
EXTSFF	Half Palus, Half Rosy, without distinction.

According to these designations, it is by no means rare to find the absurd marks of

EXTSFRPP,

which is to be understood thus:—

Extra Superfine Fine Pure Red Palus.

It must be confessed that such absurdities can only exist in a country where fraud has made revolting progress. It often happens that the mark EXTSF, now used, is not equal to the old one of SFF.

The *extra fine* is especially manufactured with the heart, or the ligneous part, of the root. This mark gives less depth, because the ligneous part is less rich in coloring principle than the fleshy part, or the bark, of the root, but it affords a much more lively color. The madders of Avignon are packed in deal casks of 900 kilogrammes in weight. The insides of these casks are generally lined with very thick pasteboard, in order to prevent contact with the air, which blackens the powders, causes them to appear less beautiful, and after a certain time destroys much of their tinctorial properties. Light also very quickly changes the coloring principle of these powders.

It is rather difficult to ascertain exactly the quantity of madder gathered each year in France, as well in Alsatia as in the ancient county of Venaissin.

In 1837, the crop of the Lizaris amounted, in these districts, to 1,200,000 kilogrammes, which is equivalent to from 48,000 to 50,000 barrels, of which part was sent to the different places where it is consumed, as well within as without the country, conformably to the following table:—

	Kilogrammes.
Rouen, Havre, and Dunkirk,	3,800
Antwerp,	500
Genoe and Leghorn	183
London, Liverpool, and Glasgow,	3,760
London, Liverpool, and Glasgow, 8000 bales of lizari, which represent	3,500
Hamburgh,	530
St. Petersburgh,	1,608
Odessa,	110
Rotterdam,	423
Trieste,	205
New York and Boston,	812
Mulhausen, Strasburg, Metz, and Basle, for the consumption of Alsatia, Prussia, Switzerland, Bavaria, Austria, &c.,	15,000
Total,	30,481

There remained, therefore, of the harvest of 1837, at Avignon, and in the department, from 18,000 to 20,000 barrels, when the harvest of 1838 was about to be got in. This, although less than the former, amounted to between 36,000 and 40,000 barrels.

The manufacture at Avignon is always in a prosperous condition.

The state of the customs shows that in 1840 there was exported from France 2,161,158 kilogrammes lizaris, which represent in value 1,620,869 francs, and 12,114,054 kilogrammes of madder, equal to 12,114,054 francs; that in 1841 there were exported 1,896,416 kilogrammes of lizaris, equal to 1,422,312 francs, and 11,840,886 kilogrammes of madder, equal to 10,840,886 francs.

The importation of foreign lizaris and madders is very small, on account of the heavy duties. The lizaris chiefly come from the Levant by way of Turkey, the Barbary States, from Tuscany, the two Sicilies, and from Germany. The madders come especially from Holland and Belgium.

IV.—*New Commercial Products derived from Madder.*

Since 1836, two new products occur in commerce, which are destined to replace madder in the operations of dyeing and calico printing. One is known by the name of *garancine*, the other by the name of *colorine*.

A. The *garancine* is a more, or less, clear chocolate colored powder, without any decided smell, or taste; it does not impart any color to the saliva, or to cold water even by long contact.

This garancine is nothing further than the *charbon sulphurique* of MM. Robiquet and Colin,* deprived of every trace of acid. A patent was taken out on the 26th of March, 1828, by MM. Lagier, merchant, and Robiquet and Colin, Professors of Chemistry, for the manufacture and sale of this new product. As the specification which contains the description of the process of manufacture has never been published in any scientific work, I think it right to notice it in this place.

"The problem to be solved," says the patentees, "is to obtain the whole of the coloring matter of the madder free from the foreign bodies which tarnish its lustre, and retain it in combinations different from those which it ought to contract with the mordants; now the madder in its natural state contains coloring matter in various conditions. Thus in the dyer's bath it separates into two portions, one of which is either dissolved, or suspended, in the water, whilst the other remains fixed in the ligneous residue. In treating the exhausted residue, which is generally considered worthless, by the method described below, a quantity of coloring matter, at least equal to that first extracted from it, is obtained. Besides, the portion which the water carries with it, either in solution, or in suspension, is far from being attracted by the mordant of the stuffs immersed in it. A great part remains in the bath, in combination with some substances which retain it with sufficient energy to prevent it from combining with the mordants beyond a certain limit."

* Société Industrielle de Mulhausen, t. i. p. 162.

The following is the process proposed by them:—"The madder is immersed in from 5 to 6 parts of cold water, and allowed to macerate all night, in order that the portion of the coloring substance which dissolves at first, may have time to subside; the whole is then thrown on to linen strainers, and when the liquid has passed through, the grounds are pressed; they are then immersed again in the same quantity of water, pressed, and this operation repeated once more. After these three washings, which serve to remove a green substance, besides sugar, mucilage, and other soluble substances, the grounds, still moist and well crushed, are mixed with sulphuric acid equal to half the amount of madder first employed; it is, however, requisite that this acid should be diluted more, or less, with water according to the temperature; this is done when it is about to be employed, in order to turn to account the heat set free by the mixture. The acid thus diluted is poured quite hot over the madder; it is then agitated as rapidly as possible, and when the mixture is thought to be well effected, the temperature is raised to 212° Fahr., and maintained for about an hour. At the end of this time the substance is again mixed with a suitable quantity of water, filtered, and washed on the strainers until the liquid passes off perfectly insipid. It is then pressed, dried, and passed through the sieve.

"In this operation the acid has undergone no alteration; it has merely become weaker, and charged with some calcareous salts, which does not prevent its being employed in the manufacture of sulphate of soda. The first washing water might also be turned to account, since it contains much sugar, which might easily be converted into alcohol."

Garancine was first introduced into commerce by the house of Lagier & Thomas, of Avignon, towards the year 1829, who had bought the process and the patent of Robiquet and Colin; but this product did not meet with success in the market. The neutral state in which it was delivered not affording any correction to the calcareous waters ordinarily used in our Rouen print works, and the action of their alkali on the coloring principle not being properly understood, the experiments which were made with it on a large scale were far from corresponding to those made with smaller quantities, and threw it into great discredit. It was not until later (in 1832) that the same house in Avignon, assisted by the advice of chemists, again commenced some trials, the results of which proving satisfactory, led to the belief that its use might become of importance. At this epoch, however, the madder prints in vogue, being very dark, and requiring a strong dye, could not be produced with garancine; the great quantity of coloring matter which they required, prevented its use on account of its price; but in 1835, the issue of certain kinds of colored prints requiring very bright colors, again drew the attention of manufacturers to garancine, and it was generally adopted and approved of.

Many persons, forseeing how important its consumption might become, started establishments for the manufacture of it on the expiration of Robiquet's patent granted to Lagier & Co. Want of expe-

rience in this process caused these first manufacturers to obtain but imperfect products, and many soon left off; but shortly after, some persons, profiting by the experience of their predecessors, again took it up, and there are now from twelve to fifteen manufacturers of garancine at Avignon, and one or two in Alsatia.

The manufacturers of Avignon employ only the madder of the Comtat; those of Alsatia are, it is said, obliged to add a small quantity of the former to the madder which they grow, in order to increase the quantity of coloring matter of their garancine.

From 1839, this substance began to be generally employed in several of the principal print works of Rouen, among others by M. Schlumberger-Rouff, who manufactured the garancine which he used according to the following process:—

After having ground the already pulverized madder on a table, by means of a thick, wooden rolling pin, such as is used by pastry cooks, it is placed in a leaden basin, then moistened with a little water, and half its weight of sulphuric acid of 1.834 sp. gr. poured over it, whilst two men continually stirred the mass with shovels, walking around the basin. When the burning *(brûlage)* was ended, it was washed five, or six, times in barrels, the product drained upon linen, and then dried in a chamber heated by steam. It was afterwards ground in a water mill, made upon the plan of pepper, or coffee, mills. This garancine was very acid, and could not be used for violet colors. It cost 3 francs 75 centimes the kilogramme.

Originally garancine was worth 6 francs the kilogramme. For the last three years, the current price, without distinction whence it came, has been from 4 francs 50 centimes to 5 francs the kilogramme, with a discount of 6 per 100.

Up to the present time it has not been possible to class garancines according to their quality. Each manufacturer seeks to obtain the best products with regard to the quantity of coloring matter, and also with regard to the brightness of the tints; but the impurity of the first matters, and the neglect of trifling circumstances which the manufacture requires, often cause the products of the same manufactory to vary considerably. In trade, garancines are met with which afford four times more coloring matter than the madder which was employed to obtain them, whilst others give but two and a half.

This want of regularity is as much dependent on the degree of richness of the madder employed, as on the operations necessary in the production of the garancine; there is so much danger of burning the madder too much, or too little, that it is quite impossible to produce an identical garancine during a year. In great manufactories it is hardly possible to make from fifteen to twenty barrels which shall be nearly alike; for which purpose it is even necessary that the whole mass of roots required should be treated at one time. In general, good garancines possess three times as much richness of dye as the good madders.

The same mode of classification has not been adopted for the garancines as for the madders; the former are only distinguished by the names of the manufacturers.

The garancine, both of Rouen and Alsatia, is packed in casks of from 200 to 300 kilogrammes. That of Avignon is exported in casks, lined interiorly with blue paper, and with the jointures coated with tar.

During the last three years the consumption of garancine has been pretty regular; it may be calculated at from 1600 to 1800 barrels a year from Avignon, and from 400 to 600 barrels from Alsatia.

Before the introduction of this product into our manufactories, the yearly consumption at Rouen was from 3200 to 3500 barrels of Avignon madder, and about 1000 of Alsatian. For the last three years not more than about 2000 barrels of Avignon madder have been consumed, and 200 barrels from Alsatia. This diminution of nearly half the consumption of madder, is more than compensated by that of the garancine, and the Lizaris. The consumption of these last has, however, been almost nothing for five or six years; it may be valued at from 500 to 600 bales of every growth a year.

The following is the behavior of garancine towards solvents:—

Cold distilled water, . . . After 24 hours of contact it has only assumed a pale yellowish color.

Distilled boiling water, . . . Acquires a pale reddish yellow tint.

Cold calcareous water, . . . After 24 hours it is less colored than with cold distilled water.

Boiling calcareous water, . . A somewhat paler tint than with distilled boiling water.

Cold lime water, ... After 24 hours the tint is paler than that with distilled boiling water, and than that with boiling calcareous water.

Water acidulated with sulphuric acid, Takes, after some hours, a slightly greenish yellow tint.

Water acidul. with hydrochloric acid, Id., a rather darker tint.

Cold dist'd water acid. with nitric acid, Id., a rather darker tint, and the blackish gray powder becomes of a brownish red, resembling madder become brown by age.

Cold dist. water acid. with acetic acid, Becomes faintly yellow.

Acetic acid of 1.0704 spec. grav., . Acquires, after several hours, a beautiful reddish yellow color.

Caustic ammonia, ... Becomes red immediately, and after 24 hours the liquor is strongly colored crimson red, so intense that it is no longer transparent in a great mass.

Water slightly alkalized by ammonia, Immediately assumes a beautiful claret red color.

Caustic soda, ...	A dark reddish brown color.
Water charged with carbonate of soda,	Acquires quickly a bright reddish color of Burgundy wine.
Cold alum water, ...	Becomes almost immediately of a chrome red color.
Boiling alum water, ...	Acquires immediately a dark red color, and, upon cooling, deposits flakes of the same color, but paler.
Alcohol of spec. grav. 0.863, . .	Assumes rather quickly a slight reddish yellow color.
Hydrated ether, ...	Id., id.

Dyeing with garancine is effected in just the same manner as with madder. It is more advantageous, however, to raise the bath at once to 113° Fahrenheit, and then gradually to 167° or 176°. Garancine only yields its color to the tissue impregnated with the mordant at a boiling temperature. The water of the bath acquires no color even after ebullition, which always terminates the dyeing with garancine.

The mordants are the same as those which are employed for dyeing without madder.

For certain colors in which there is no violet, sumach is sometimes added to the bath to the amount of about a third of the garancine employed. At other times, for red grounds, for instance, the pieces are quercitroned before garancing, which imparts much brightness to the red, but renders the violet grey.

The proportion of garancine used in dyeing calico prints varies considerably, according to the intensity of the tints, and the quantity of color required by the pattern.

When the garancines are neuter, and the waters are calcareous, which is general in Normandy, they must be corrected by adding a variable proportion of sulphuric, acetic, or oxalic, acid to the bath. 1 centilitre of sulphuric acid of 1.028 to 9 litres of water, or 15 centigrammes of oxalic acid to a litre of water, are about the quantities employed. When sumach is added no acid is employed.

There are some garancines which are badly washed and acid, and to which it is, therefore, necessary to add chalk, or alkaline carbonates, in order to get rid of the too great excess of acid, which would be injurious; but chalk and alkalies are avoided as much as possible.

The great advantage of garancine is that it does not *charge* the white, and that the bleaching of the stuffs dyed with garancine is reduced to a mere nothing. When a very pure white is not required, it suffices merely to beat, and sufficiently clear, the pieces after the garancing. When a perfect white is required, the pieces are passed through bran for fifteen, or twenty, minutes. Hot water, or bran, are the only means used for clearing them. In this respect, therefore, garancine possesses a great advantage over madder which covers all the whites, and which renders it necessary to use soap, and to clear them more, or less, after the process of dyeing.

The tints obtained with garancine are generally more brilliant and

lively than those with madder. The *red* is vivid, of a carmine color of extraordinary purity, whilst the madder red placed by its side is always somewhat yellow, or of a fawn color, and dull, but, on the other hand, fuller. The *puces* and *garnets* made with garancine are much more velvety than those dyed with madder. The *violets* are not so pale, and delicate, and grey as with the latter. All the tints are weaker, and cannot so well bear soaping; they also require great care in the clearing, and resist less the action of the atmosphere and of the sun.

All the garancines, however, do not afford tints of equal richness and brilliancy. Some kinds produce a beautiful red, but a bad violet color; other kinds afford a magnificent puce, or violet, while the red is dull brown.

Garancine was first employed in the calico print works of Normandy. The Alsatian works refused to use this product for a long time; they only began to employ it about two years ago, in imitation of the calico printers of Rouen.

M. Leonard Schwartz, of Mulhausen, has recently sent into commerce, garancine prepared from the residue of madder which has been already used for dyeing. This matter, which he very improperly calls *garanceux*, is of much less value than the good Avignon garancine; 3½, and even 4 parts, are scarcely equal to 1 part of the latter. It costs 2 francs 25 centimes the kilogramme.

B. The *Colorine* of commerce is the residue from the distillation of the alcoholic liquid obtained in the treatment of the *charbon sulphurique* with spirits of wine. The residue, which consists of *alizarine*, still impurified with a little fatty matter, is in the form of an extract when withdrawn from the retort. It is diluted with a little water, and pressed, in order to separate the fatty matter from it as much as possible. When dry it is reduced to powder. This is Robiquet and Colin's* *alcoholic extract of charbon sulphurique*, which MM. Ligier and Thomas, of Avignon, brought into the market in 1836, at 75 francs the kilogramme.

This product is in the form of a very fine powder of a yellow ochre color, without any decided smell, or taste; moistened, it stains the fingers strongly of a yellow color, but it hardly colors saliva. It presents all the chemical characters which Robiquet and Colin assigned to their alizarine.

The expectations which had been entertained by these skilful chemists, as early as 1827, as to the possibility of using alizarine for obtaining colors of application, were realized in 1837, by M. Pariset, of Rouen, who was then chemist in the works of MM. Feer, Dolffus & Company, of Dieppdalle, and formerly pupil of M. Chevreul; and simultaneously in 1838, by M. Gastard, chemist to M. Stackler, and M. Daniel Fauquet-Delarve, of the print works at Deville. Colorine dissolved in ammonia, and the liquor being thickened with gum, affords, in fact, when printed on calicoes with aluminous mordants, and exposed to steam, red and rose colors, which are, by no means,

* See MM. Robiquet and Colin's Memoir, (Bulletin de la Société Industrielle of Mulhausen, i. pp. 177, 178 and 181.)

inferior to those obtained with madder dyes. A patent for fifteen years was taken out on the 24th of November, 1837, by M. Stackler, for the carrying out the processes of M. Gastard; but the high price of the colorine of MM. Lagier and Thomas, prevented their adoption in the print works. The same was the case with regard to the processes of M. Daniel Fauquet, who obtained in large quantities more intense and richer reds than those of M. Gastard. M. Fauquet's processes possessed another advantage, in so far as he was able to cause his red to *re-enter (rentrer)* upon black grounds dyed with logwood and other dyes, and as this red did not require so many clearings as that of M. Gastard, to obtain vividness and brilliancy. M. Fauquet manufactured a large number of prints with applied red and rose colors, both in England and Scotland, but the enormous price of the primitive matter prevented his continuing. The Society of Emulation, of Rouen, on my report, decreed medals of encouragement to MM. Gastard and Fauquet, in 1839, for being the first to convert an experiment of the laboratory into an operation of the arts, and showing, in an indisputable manner, the justice of MM. Robiquet and Colin's presuppositions, viz., that it is possible, and even advantageous, to manufacture on a grand scale solid colors direct from the madder.

In 1840, M. Grelley and I undertook to investigate carefully the possibility of the practical application of the pure alizarine of Robiquet, a problem of the greatest consequence, since the *Société Industrielle*, of Mulhausen, proposed, in 1834, a premium of 19,900 francs, to be raised by subscription amongst the principal dyers and calico printers of France, for the *discovery of a red of application from madder*, the price of a pot of the color (containing two litres) not to exceed 10 francs.* This premium, which was continued until 1839, was never gained, and has been withdrawn. These facts show the great difficulty of the question. MM. Grelley and I have at last been able to solve it, by obtaining colorine at a price which allows of its being generally employed in producing red and rose colors of a good tint. We have described our processes in two *sealed packets*, deposited in the *Archives de l' Académie des Sciences*, dated 24th June, 1841. We have since brought our processes of extraction to greater perfection. Our product is of as good a tint as the best reds obtained in the ordinary method of dyeing; it bears all the customary clearings, and since it is far more brilliant even in its natural state, it more readily yields to the action of the clearings than the ordinary madder-reds. Used in very small quantities, it resists the strongest clearings that are employed for Turkey red, which generally requires an excess of coloring matter. This product may be used with the greatest facility. It is mixed with weak ammonia, and left in it to swell; it is then thickened with gum water, or with gum in powder, and applied to the tissue. The operations it requires after its application, only consisting in a simple steaming and rinsing with pure water, it may be printed, in every case, with all the other ordinary steam colors, provided it is not intended to be cleared. The prepar-

* Bulletin de la Société de Mulhausen, vii, p. 394.

ations preliminary to its application allow of its being applied to black grounds, or others obtained with matters of weak tint. It can be used of different degrees of strength on the same stuffs, and it it is thus possible to obtain tints from a pale red to the very darkest red.

We have applied it on black and white grounds, which, up to the present time, were injured in the ordinary operations of dyeing. We have also applied it with catechu, when the clearing required was merely a simple soaping. Lond. Chem. Gaz.

To be Continued.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on Warming Dwellings with Furnaces. By Franklin Peale.

The warming of houses, in our variable climate, is of such importance to our domestic comfort, as to demand careful consideration and attention, not only with regard to the primary object of maintaining an equal and sufficiently elevated degree of temperature, but also to health and economy; health and comfort may be considered synonymous, and the greatest amount of the two procured at the least expense, is the object towards which our endeavors are directed.

The subject is naturally divided into three branches:—

The first is of primary importance, and almost self evident—the advantage which is derived from *warming* large quantities of air, instead of *heating* small quantities, as is too frequently the case. By warming air in abundance, and conducting it into the apartments, an equal and summer-like temperature may be maintained throughout; the parts of the rooms furthest from the supply receiving a liberal share; whereas, if the air is over heated, it ascends to the upper part of the rooms, whilst the lower portions remain cooler, the discomfort of this state of things being augmented by an influx of cold air under wash-boards, at window-sills, &c., a sufficient explanation of the cause of the oft repeated complaints of cold feet in rooms generally over heated by furnaces of faulty construction.

The second branch of our subject, and the next in importance, is the general circulation of the air of the house, the entries and stairways entering into, and forming a part, of the system.

Warm air in large quantities being conducted into the rooms, it should be allowed to flow out through the open doors, the often repeated order to "shut the door after you," being not only unnecessary, but "more honored in the breach than in the observance." The cooler air of the entries and stairways descends in slow currents to continue the circulation, and it is essential that this descending current should be *entirely unimpeded;* any passage less than an ordinary doorway would diminish the object in view.

In all houses properly constructed, the means of warming should be determined and provided for, before a single foundation stone is laid, otherwise if the warm air system is subsequently adopted, which

is generally the case, there are numerous piers piercing the building from cellar to garret, mantels, grates, wide chimney places, &c., all of which are not only unnecessary, but actual incumbrances, reducing the size of the rooms, destroying their symmetry, and otherwise impairing their architectural proportions.

In houses planned with reference to warm air circulation, this important object can be readily and conveniently attained. In those of ordinary construction, a portion of the cellar is generally used for the location of the furnace chamber, (the word chamber being employed to designate the brick work which encloses the heating apparatus, consisting of furnace and drums, &c.) It will be necessary, in this case, to maintain the apartment, thus employed, neat and clean. It cannot be used as a receptacle for wood, vegetables, or other domestic stores: these matters must find another resting place, or the occupants of the house will have the annoyance of exhalations of a disagreeable character.

It is essential to exclude, carefully, the external atmosphere from a cellar employed with the object above stated, and of no small importance in any case, for otherwise, in winter, there is a temperature, it may be, of zero, within an inch and a half of the soles of our feet, which fact, if not the origin of the American custom of sitting with the feet elevated, is, at least, some excuse for it.

To accomplish the two objects, briefly stated above, that of warming an abundant supply of air, and procuring its general circulation, it will be necessary to construct the whole apparatus with this view: hence the necessity of a chamber of a size sufficient to contain a large amount of surface for the radiation of heat from horizontal drums, with a furnace and its appurtenances. This chamber must surround and enclose the furnace and drums to the level of the *grate*, but below that point it might be entirely dispensed with, so far as the warming of air is to be considered; in actual construction it should present as little obstruction as possible to the influx of air. Three sides entirely open to the foundation would be the most desirable form, with piers at the corners for its support, and one side entirely closed for certain other objects to be noticed hereafter. The temperature of the air being raised a single degree by its proximity to the furnace, its tendency to rise will effectually prevent any loss of heat; it has neither tendency nor ability to descend, and, therefore, need not be obstructed, or controlled, elsewhere, than at the registers by which it passes into the rooms which it is intended to warm.

From the chamber, flues lead the warm air into the various apartments, according to the system which these remarks are intended to illustrate. These flues should be of large area, clean, and smooth; the registers by which the admission is to be controlled, should rather exceed than fall short of the desired magnitude.

There are many situations in which it is desirable to convey the warm air horizontally to considerable distances, for the purpose of warming lateral apartments. If the chamber is constructed as above described, and the supply, or descending currents, as we have called them, be unimpeded, there is no difficulty, whatever, in so conveying it;

if, on the contrary, as is most frequently the case, the supply is limited to a few inches of area, either to the chamber, or the apartment in which it is placed, neither force nor persuasion will induce the air to take the unwonted course, and this obstinate conduct has been a sad puzzle to the uninitiated: indeed, there have been cases in which the projectors and builders have been astonished to find little or no heat making its way into rooms directly over the furnace, when the chamber was constructed with small apertures, and sometimes tortuous passages, for the admission of a minute quantity of air. How warm air was to come out of an arrangement, in the construction of which so much care had been bestowed for its exclusion, was indeed a mystery.

It is from this cause, principally, that so much prejudice has existed, and still continues to prevail, against the use of furnaces. The air, owing to the small area of the apertures for its admission, becomes over heated; the occupants of rooms, in order to get enough of heat, are obliged to make, or order, strong fires; particles of animal and vegetable matter floating in the air, coming in contact with red hot surfaces of iron, are carbonized, or decomposed, and hence arise effluvia, "vitiated air," head-aches, and antipathies to furnace heat, with numerous other objections, which have their origin, not in the system, but in the bad construction of the apparatus.

There are those among us who tell us that they love to look upon the cheerful blaze, and that they miss the sight of the fire: this is altogether a matter of association; if the parties can be made more comfortable without it, they will not miss it. He must be a chilly mortal, indeed, who would desire to gaze upon a bright blaze in June, or to toast his trotters over a glowing coal-heap in July.

Cases have occurred in which, to the no small surprize of the experimenter, a current was found to flow *into* the register, instead of the desired one *out* of it, like some refractory chimneys in which the draft is the wrong way, which perplexing circumstance remained a mystery, until a little careful examination showed that it was a natural result, in accordance with the laws which control this matter; in fact an inevitable consequence of the construction of the chamber, or of the apartment in which it was placed.

The explanation is as follows: Two separate air flues lead from the chamber of a furnace into apartments in the first, and second, or third, stories, of a house; we will suppose it to be the third story; there is, therefore, a column of heated air, in one of them, two stories high, with a strong draft upwards as a natural consequence; there is also a shorter column of heated air in the flue leading to the first story, which has also its tendency upwards, but as the furnace is so situated, or constructed, as not to supply a sufficient quantity for either of the flues, it follows, as a natural result, that the draft of the longer flue overcomes the draft of the shorter, and a current is established downwards in the shorter flue out of the lower apartment to supply the upper; in fact, in this case there is an inverted siphon of air flues, the longer limb of which overcomes the upward force of the shorter, and thus the lower apartment is "racked off." There is at present

an arrangement of apartments under our control, in which this effect can be produced at will.

The third branch of our subject has reference to cleanliness alone. The saving of domestic labor, and the comfort, however, which it is instrumental in aiding, render it of no small importance.

All house-keepers know the consequence of "raking out" a grate, in distributing ashes, in the form of a gray powder, in an even stratum, over the furniture and fixtures of an apartment. This annoyance can also be caused by furnaces; generally, however, in a modified degree. The remedy, is easy and effectual. The fuel and ash doors and grates should be placed in an apartment separated entirely by a partition, or wall, from that which contains the chamber, or supplies it with air. This separate apartment should contain the stock of fuel, and the passages to it should be carefully guarded by doors, with pullies and weights, so as to leave no excuse for their remaining open longer than may be necessary to give ingress, or egress, to the attendants.

The preceding remarks have reference to the construction and general principles of management. A few additional ones are demanded on the subject of the supply of air; and it is proper to add that they are the result of observation after long experience, as well as theoretical views, based upon a careful consideration of the subject.

If air is introduced from the external atmosphere, or, to use the common phraseology, from out of doors, care should be taken that the conductor by which it is conveyed should be very large, and that it should have its external termination in a pure locality. A narrow alley, with its gutter and garbage, cannot with propriety be considered a good source for the supply of wholesome air. A great inconvenience, however, must always exist in the variable temperature of the external atmosphere, causing difficulty in the management, besides additional expense, as more fuel must be consumed to meet this variable condition. Experience has shown that the occasional opening of external doors, and the numerous small openings in window frames and sashes, in entries and stairways, give an abundant change of air for all ordinary dwellings, and in all well constructed furnaces a complete and effectual ventilation of rooms can be had at will.

In churches and halls where large concourses are collected, two modes of management may be adopted; the first should, in the absence of the congregation, or audience, circulate the air of the building, by allowing it to descend through ordinary passages, such as stairways, if there are any, to the chamber of the furnace, or if there are none, then openings must be made through the floors, and, if need be, covered by gratings; this mode will be found not only more economical, but will warm more effectually the walls and fixtures, by which condensation of moisture upon them may be prevented; the second mode should be employed when a change of air is requisite, from the number of persons collected together, and is readily accomplished by opening a passage from the external atmosphere to the chamber of the furnace, or the apartment in which it is placed.

With regard to the use of water, little need be said. I am quite at

a loss to understand the part it plays in furnace warming. It is true that furnaces, especially those which overheat the air, exercise a drying influence upon furniture and wood work, because the capacity of air for moisture increases, within certain limits, as its temperature is raised. It is not necessary, however, to discuss the question, and it is left with the closing remark, that those who desire it, can, in any form of furnace, evaporate water, and send the vapor into their apartments to saturation if they prefer that condition.

In an economical point of view, it has generally been conceded that a stove of good construction is the cheapest means of warming an apartment; yet it can be demonstrated that the same stove, out of that apartment, will warm it more comfortably than when placed within it; and this apparent paradox is solved by placing it in a chamber constructed and supplied with air, upon the principles set forth and endeavored to be explained in the foregoing remarks; that is to say, if the same stove should be placed in a chamber, supplied abundantly with air, either from the external atmosphere, or by circulation through entries, an apartment above it will be more equally and agreeably warmed, with a reduced expenditure for fuel.

It is well known that there is a deposit of gray ashes, or dust, in the flues of furnaces, in which anthracite is the fuel employed; and that it is capable of exercising a corrosive action sometimes so rapidly as to destroy the iron pipes in which it rests in a very short time. It has also been observed that this corrosion does not take place whilst the furnace is kept in operation, except in those cases in which the iron pipe passes into the external atmosphere.

This destructive effect is caused by a deposit of the muriate and sulphate of ammonia, or other salts, which remain in a dry crystaline form as long as the fires are continued; but when these are no longer used, they seize upon the moisture of the air in damp weather, or from the damp location of the furnace, are dissolved and decompose the iron.

For further information on this subject reference may be had to the report from the sub-committee on corrosion of iron in steam boilers, when anthracite is employed as a fuel, in the Journal of the Franklin Institute, vol. iii, March, 1842.

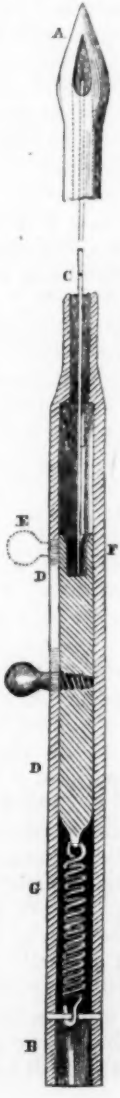
The remedy for this evil is so to construct the drums that one end of each shall pass through the wall of the chamber, and be furnished with a head, or cover, that can be removed, or to construct the whole series of drums in such manner as to allow their entire removal, both of which plans are followed in this city. In either case they should be carefully swept out and cleaned at the cessation of fire making for the season. White-washing the interior of the pipes with a thick wash of lime, has been found to be efficacious: drums thus treated have been in use six seasons, and are still in good condition.

It is not by any means necessary to consider these remarks as confined to warming by anthracite as the only fuel, or to dwellings in cities. They are even more applicable to country houses, and to wood, or other fuel. It is conceded that hard coal is the fuel which gives the largest amount of heat, with the least amount of labor for its atten-

dance; but it is also equally true that other fuel is largely and necessarily employed, to which the foregoing remarks are equally applicable, and, in some respects, even more so, than under the ordinary circumstances which have engaged our attention.

Philadelphia, April 18th, 1844.

Description of an Improved Wire Tube for Weaving Wide Velvet. *By* Mr. David Bond.



In weaving wide velvet, the wire on which the loops of the pile are formed, and afterwards cut, is conveyed into the shed of the warp by being placed in a tube; for the invention of which the Society rewarded Messrs. Hanchard, Cole, and Sodo, in 1839.

The defect in Mr. Hanchard's tube appears to be the liability of the wire sticking between the internal surface of the tube and the spring plug, which is used for pushing out part of the wire at the end of the tube, (A, in the accompanying section,) so that the wire may be held while the tube is withdrawn from the opening of the warp.

The injury thus occasioned to the wire in the original tube, besides the loss of time, renders Mr. Bond's improvement valuable to wide velvet weavers generally.

Mr. Bond makes the butt end of the tube B F, which contains the plug, larger than its main body A C, so that the wire may not be conducted to the edge of the plug, and thus become fixed between it and the inner surface of the tube. The spring G, draws back the slide as usual.

In the section A and B, are the two ends of the tube, the middle portion being omitted to save space. The wire is placed entirely within the tube through the opening at A, its lower end resting against the slide D. In this position the tube is ready to be passed across the warp, and when that is done the assistant pushes up the slide D, by its handle E, which will cause a sufficient length of the wire to protrude at the opening A, to enable the weaver to take hold of it; the tube is then withdrawn, leaving the wire in its place.

Trans. Soc. Arts, &c.

Professor Faraday's Invention for the Perfect Ventilation of Lamp Burners. By JAMES FARADAY.

In consequence of the injury sustained by the books in the library at the Athenæum Club, amounting almost to the entire destruction of the bindings, and the complaints of the members of the vitiated state of the air in the rooms, causing headache, oppressive breathing, and other unpleasant sensations, Professor Faraday's attention, as a member of the club, was drawn to the subject of ventilating lamp burners in houses, and he was induced to suggest the trial of various plans for effecting the removal of the products of combustion produced by sources of artificial light. All substances used for the purposes of illumination may be represented by oil and coal gas; although tallow and wax are also employed to a considerable extent, yet as until they are rendered fluid, like oil, they cannot be burnt. Now oil and gas both contain carbon and hydrogen, and it is by the combination of these elements with the oxygen of the air that the light is evolved. The carbon produces carbonic acid, which is deleterious in its nature, and oppressive in its action in closed apartments, and the hydrogen produces water. A pound of oil contains about 0.12 of a pound of hydrogen, 0.78 lb. of carbon, and 0.1 lb. of oxygen; when burnt it produces 1.06 lb. of water, and 2.86 lb. of carbonic acid; and the oxygen it takes from the atmosphere is equal to that contained in 13.27 cubic feet of air. A pound of London coal gas contains, on an average, 0.3 lb. of hydrogen, and 0.7 lb. of carbon; produces, when burnt, 2.7 lbs. of water, and 2.56 lbs. of carbonic acid gas; consumes 4.26 cubic feet of oxygen, equal to the quantity contained in 19.3 cubic feet of air. So a pint of oil when burnt produces 1¼ pint of water, and a pound of gas produces above 2½ pints of water; the increase of weight being due to the absorption of oxygen from the atmosphere, 1 part of hydrogen taking 8, by weight, of oxygen, to form water. A London Argand gas lamp, in a close shop window, will produce, in four hours, 2½ pints of water, to condense, or not, according to circumstances, upon the glass, or the goods, as it may happen. Also a pound of oil produces nearly 3 lbs. of carbonic acid, and a pound of gas 2½ lbs. of carbonic acid. Now carbonic acid is a poison, an atmosphere containing even $\frac{1}{10}$th of it is soon fatal to animal life.

Mr. Leblanc has recently analyzed carefully the confined air of inhabited places, and concludes, as stated in his memoir, that the proportion of carbonic acid gas in such places may be regarded as measuring with sufficient exactness the insalubrity of the air; that in the proportion of 1 part to 100 of air, ventilation is indispensable for the prevention of injury to the health; that the proportion of carbonic acid gas had better not exceed a 500th part, though it may rise without inconvenience to a 200th part. If a lighted taper be applied to the top of a lamp chimney, it will be instantly extinguished, or a glass jar held over it will become immediately filled with air in which a light cannot burn. Also sulphurous and sulphuric acid are contained

in the water, which results from the combustion of coal gas, and are products injurious to metals and articles of furniture.

The object sought to be obtained in the ventilation of lamp burners, is the entire removal of all the noxious products of combustion, and with this view, at Professor Faraday's suggestion, the gas lights of the chandelier, in the library at the Athenæum, were ventilated by pipes dipping into the lamp glasses, and conjoining, at a short distance upwards, into one central pipe, which carried away all the burnt air from the room. In this first practical experiment many things were learned as to the mode of arranging the pipes, the disposal, when the pipes were very long, of the water produced, &c. &c.; but the objects sought for by the ventilation were at once and perfectly obtained.

Next arose the desire of modifying the system by removing the ascending flue from its place over the lamp, not from any deficiency in action, but for appearance sake only; and finding there was sufficient ascension power in the main part of the metal chimney to allow of a descending draught over the lamp, the tube, in place of going directly upwards, was made to turn short over the edge of the glass, to descend to the arm, or bracket, to pass along it, and then ascend at the central part of the chandelier, or against the wall, if applied to a single light. The gas light has its chimney, as usual, but the glass holder is so constructed as to sustain not merely the chimney, but an outer cylinder of glass, larger and taller than the first, and closed at the top by a plate of mica, or, still better, by two plates of mica, one resting on the top of the glass, and the other dropping a short way into it, and connected together with a metal screw and nut, which also keeps them a little apart from each other; thus forming a stopper which cannot be shaken off, but is easily lifted on and off by a small metal ring, or knob, at the top. The glass holder has an aperture in it connected by a mouth piece with a metal tube, which serves as a ventilating flue, and which, after passing horizontally to the centre of the chandelier, thence ascends to produce draught and carry off the burnt air. Now, with a lamp burning in the ordinary way, the products of combustion issue out as a torrent of ærial impurity from above; but if the above arrangement be applied on closing the top of the outer glass cylinder by the plate of mica, all the soot, water, carbonic acid, sulphurous and sulphuric acid, and a portion of the heat, are entirely carried away and discharged into a chimney, or the open air; and the air in rooms may thus be kept in the same wholesome condition, and as fit for the purposes of respiration as if artificial light were not being used.

A curious but important result of the enclosed lamp is the increase of light produced, amounting to from ten to twenty per cent., according to circumstances, the same quantity of gas being consumed as before. If the current of air through a lamp glass, when the gas is burning in the usual manner, be diminished, the flame rises in height, and the light is increased in amount, but is of a redder color; the combustion, in fact, is not so intense, because the excess of air is retarded, the particles of carbon which give the light are not so highly

ignited, but are more abundant, and are ignited for *a longer time*, thereby causing an increase of light. Ibid.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Fixation of Photographic Images by means of a Silver Bath.

Plunge the plate into a silver bath (cyanide of silver dissolved in cyanide of potassium) upon removing it from the mercury, let it stand for a few seconds, until the sensitive coat is dissolved, then establish the galvanic current. In 8 or 10 seconds the proof is fixed.

Its advantages are, first, it gives such great brilliancy to the lights, that the solarized parts become generally beautifully white; secondly, silver being a photogenic metal, the plates may be easily reprepared for use by rubbing with dry tripoli; thirdly, if you pour over a proof when taken from the mercury, or when fixed by silver, or chloride of gold, concentrated hyposulphite, and bring the liquid nearly to boiling, the proof takes little by little the most rich tints, passing successively from yellow to red, and from red to blue; the zinc pole determines these colors in the cold at the points near it. Proofs already fixed by chloride of gold give the richest colors.

Researches for the purpose of procuring a substance not containing Lead, to replace White Lead in the Arts.

The number of individuals affected with the lead disease, (colica pictonum) admitted during eight years, at the Hospice de la Charité, was 1163. Of this number 406 were workmen employed in the manufacture of white lead, and 385 were painters. In the year 1841, the Department of the Seine furnished 302 sick, of which 69 were painters, and 233 manufacturers of white lead; of this number 12 died, and 1 became deranged. Of the 233 sick, the manufacture at Clichy furnished 161, and of the 12 dead, 7 were from this establishment, the only one yet which employs upon a large scale a particular method of manufacture.

None of the hopes founded upon peculiar methods for making white lead, have, as yet, been justified by experience upon a large scale. The dangers are, therefore, inherent in the employment of lead; and we believe that the only sure method, à priori, to preserve a class of workmen, of whom Paris alone contains near 8000, is to replace white lead by a combination not containing that metal. In consequence we give in our memoir a table of the preparation, and practical testing of a considerable number of white compositions.

Of this number two alone united the conditions of utility, economy, and salubrity. The first was a product which, although inoffensive, might in criminal hands, by means of very simple chemical reactions, resume its poisoning qualities; this consideration has induced us to renounce the result of a long labor. Pursuing our researches, we

have determined upon the oxide of antimony, (flowers of antimony.) It possesses the following qualities:—

It offers advantages in its employment, over white lead; by means of a method of manufacture selected by us, it is obtained directly from the native sulphuret of antimony. Its adoption will thus give a new vigor to the languid working of the mines of antimony which abound in France. Its price of production is less than the third of that of white lead of average quality.

It may be immediately ground with, or without, other manipulation. The workmen who are engaged in its manufacture, will be exempt from all danger, and it is altogether improbable that the painters who may employ it mixed with oil, will experience the least inconvenience from it.—*Comptes Rendus, Nov.* 20, 1843.

On the Desulphuration of Metals in General, applied to the preparation of Sulphuric Acid, and especially to that of Oxide of Antimony. By M. Rousseau.

The serious interest which is attached to the happy application which M. de Ruolz has made of the oxide of antimony, to replace the carbonate of lead, in all its uses in the arts, has induced me to present to the Academy, the results at which I have arrived in the desulphuration of the metals, and in particular the details of a process which M. de Ruolz has himself noticed as the complement of his beautiful idea, and to which he has given the preference as a means of rendering that idea practical. Up to this time the only method which metallurgy has employed for separating sulphur from different metals, consists in a more or less prolonged roasting; but in whatsoever manner this operation may be executed, the separation of the elements is never complete.

There is still another method of desulphuration, by which the sulphur and the metal are both, at the same time, oxidized, and the sulphuret converted into a sulphate. All chemists know, in fact, that it suffices to expose sulphuretted minerals, piled in heaps, to the atmospheric action, in order that a due combustion of the elements shall take place, and give to the sulphur and the metal all the oxygen necessary to the formation of a sulphate. The loss of time and other inconveniences which this method renders necessary, have, however, justly caused it to be proscribed in metallurgic operations. Still, by the observation of this simple and natural fact, and the reflection that if, to a temperature properly regulated, we unite the normal conditions, under the influence of which a chemical process takes place but slowly in nature, we may attain the same end in a few instants, I was led to examine what would be the joint action of air and water, upon the various sulphurets, at a temperature more or less elevated. The results were not only those of laboratory experiments, but were obtained upon masses of many thousand pounds weight. By this means all the sulphur is converted into sulphurous acid, and the metal remains in the state of an oxide, *entirely desulphuretted;* with this remarkable property, in the case of the sulphurets of iron and cop-

per, that the fragments, while they preserve their original form, increase materially in volume, and they crush under the slightest pressure. If we wish to collect and use the sulphurous acid gas for the manufacture of sulphuric acid, it is only necessary to establish a communication between the apparatus and the leaden chambers; then a proper ventilation may be established by means of the draft of chimneys, which it is easy to regulate. By these means it is possible to render useful either as ores of sulphur, or as oxides, on the one hand, the pyrites which abound so in certain localities, and upon the other, which is of much greater importance, the ores poor in metal, but rich in sulphur, such as certain sulphurets of copper, the too difficult roasting of which prevents their employment.

The preceding remarks will account for the preference which M. de Ruolz has given to this method, for obtaining the oxide of antimony from the raw sulphuret. In fact, the antimony obtained by this process is of a most beautiful white, and an impalpable powder: thus it may be employed immediately in painting, without the necessity of undergoing pulverization, or grinding. This substance, thus produced under the influence of the vapor of water, is reduced naturally to a degree of tenuity, which it is impossible to obtain by any other means.

Finally, this mode of preparation prevents the greater part of the chances of unhealthiness, if the emanations of the oxide of antimony should possess this quality, a supposition, however, which a long and well attested experience repels.—*Comptes Rendus, Nov.* 20, 1843.

Note upon the Influence of Jackets upon Steam Engines. By M. Combes.

A steam engine built by Farcot, was provided with an envelope to the cylinder, into which the steam was freely admitted from the boiler, and from which it passed as required into the cylinder. It having become necessary to repair this jacket, it was found that the expenditure of fuel was increased in the ratio of 6 to 10. A similar fact has also been observed in an engine of the same builder, erected near Sedan. A series of experiments was instituted by M. Combes, and conducted as follows:—

First, the machine was worked as usual, the steam being admitted to the jacket, and from the jacket to the cylinder; these experiments were continued for four days, the quantity of water pumped into the boiler being accurately measured, and the quantity of coal weighed; the amount of water condensed in the jacket was also ascertained, and every half hour the tension of the steam in the cylinder was measured by an indicator, and at the same time the pressure in the boiler, and in the condenser, were taken by gauges, and the number of strokes per minute of the piston counted.

Second, for three days the machine was worked by conducting the steam directly into the cylinder from the boiler, the jacket containing air only. The same observations as before were carefully made.

Third, for three days the steam was conducted directly to the cyl-

inder, but the jacket was kept in communication with the boiler, and was, consequently, filled with steam. The same observations were made as before.

The following are the results of the table:—

Exp'ts.	Duration.	Total Consumption.		Mean Pressures.			Consumpt'n per hour.		Water Evaporated by lb. of Coal.
		Coal.	Water.	Boiler.	Cylinder.	Conds'r.	Coal.	Wat'r.	
		lbs. avoir.	lbs. avoir.	Atmos.	Atmosp'e.	Atmosp'e.			
1	43*h.* 15*m.*	1482.7	8387.1	3.82	2.57	0.26	34.28	193.9	5.66
2	33*h.* 30*m.*	1982.12	11111.59	3.5	2.55	0.28	58.16	331.7	5.61
3	32*h.* 30*m.*	1469.5	7822.23	3.5	2.73	0.24	45.22	240.7	5.32

M. Combes attributes the increased quantity of fuel necessary when the jacket is not used, to the formation of water by condensation of the steam during its admission into the cylinder, and the consequent necessity of furnishing more steam to supply this loss by an additional evaporation from the boiler.—*Comptes Rendus, Nov.* 26, 1843.

Examination of Aqua Regia, and of a peculiar product to which it owes its principal properties. By M. A. Baudimont.

When a mixture is made of two parts by weight of nitric, and three parts of the hydrochloric acid of commerce, a red gas begins to be disengaged at about the temperature of 187° Fahrenheit. If this gas be passed into an U tube, which is externally in contact with pounded ice, the condensible matters which it brings with it are deposited. Experiment has shown that the first portions are mixed with hydrochloric acid, and that the last alone are sufficiently pure. This gas does not redden well dried litmus paper; but discolors it after some hours: it reddens it when moist. At 32° water dissolves .3928 of its weight, or 121 times its volume of it. This liquor is light red, and has a density of 1.1611. Enclosed in a hermetically sealed tube, it is not discolored by the long continued action of the solar rays; it possesses all the known properties of aqua regia. It may be liquified by passing it into narrow tubes plunged into a mixture of snow and salt. The liquid is dark red, but much less so than hypochlorous acid; it boils at 19° Fahrenheit. Its density at 46.6° Fahrenheit, is 1.3677. Its coefficient of dilatation measured above its boiling point in closed tubes increases very rapidly.

The density of the red gas, determined by two different methods, is 2.49. The liquid attacks all metals placed in contact with it; with the finely divided silver, obtained by the reduction of the chloride, it explodes and disappears instantly. It evaporates without attacking phosphorous.

Analysis shows its composition to be $AzO_3 Cl_2$; that is, nitric acid, in which two atoms of oxygen are replaced by chlorine.

M. Baudimont proposes to call it chlorazotic (chloronitric) acid, although he admits that it is not in reality an acid, and does not combine with bases, but forms with them chlorides and nitrates.—*Comptes Rendus, Nov.* 20, 1843.

On the Pressure and Density of Steam, with a proposed new formula for the relation between them; applicable particularly to Engines working with high pressure Steam expansively. By WILLIAM POLE, Assoc. Inst. C.E.

The relations between the elasticity, temperature, and density of steam have long been interesting and important subjects of philosophical research.

The connexion of the two former, namely, pressure and temperature, with each other, has excited the greatest attention, numerous experiments having been undertaken to ascertain the values of them at all points of the scale, and many formulas proposed by English and foreign mathematicians, to express, approximately, the relation between them.

The pressure and temperature being known, the density, or, what answers the same purpose, the relative volume, compared with the water which has produced it, may be deduced by a combination of the laws of Boyle* and Gay Lussac;† and may be expressed algebraically in terms of the pressure and temperature combined; whence, by eliminating the latter, by means of the before mentioned formula, expressions can be arrived at which will connect at once the volume with the pressure.

But there are several difficulties in the way of this process, the equations which may be thus obtained, being too complicated for practical use; and, therefore, since it is important in calculations connected with steam and the steam engine, to find a tolerably accurate, and, at the same time, simple rule, which shall give the pressure and volume directly in terms of each other, the empirical method has been resorted to.

The paper enumerates three formulas given for this purpose by M. Navier, and M. de Pambour, explaining the peculiar cases to which they are applicable, and those in which they fail; and the author then proposes a fourth expression, which is intended to meet a case not provided for by either of the others, namely, for "condensing engines working with high pressure steam expansively;" such as the Cornish, and Woolf's double cylinder engine. The equation is,

$$P = \frac{24250}{V - 65},$$

$$\text{or reciprocally, } V = \frac{24250}{P} + 65.$$

* That "if the temperature remain constant, the density varies directly as the pressure"

† That "if the pressure remain constant, and the temperature change, the volume receives a certain definite amount of augmentation, for each degree of temperature added, or *vice versa*. This augmentation is =.00208 of the volume at the freezing point, for each degree of Fahr., or .00375 for each degree of Centigrade.

P, being the total pressure of the steam in pounds per square inch, and V, its relative volume, compared with that of its constituent water.

These formulas may be adopted without considerable error, throughout the range generally required in such engines, viz., from about 5 lbs. to 65 lbs. per square inch.

Two tables are then given, showing the pressures and volumes, as calculated for every 5 lbs. pressure in this scale; they show a comparison of the results of the four formulas with each other, and the respective amount of deviation from truth in each.

The great error is,

	lbs.	
By M. Navier's formula,	1.31	per square inch.
M. de Pambour's first ditto,	4.12	"
" " second ditto,	2.75	"
The new formula,	0.71	"

The mean error is,

By M. Navier's formula,	0.245	per square inch.
M. de Pambour's first ditto,	1.42	"
" " second ditto,	0.35	"
The new formula,	0.0062	"

The tables also show:—

1st. That the new formula is nearer the truth than either of the others taken separately, in three-fourths of the scale.

2nd. That it is nearer than all three combined, in half the scale.

3rd. That the greatest error of the new formula, with regard to the pressures, is only about half as great as that of the most correct of the other three.

4th. That the mean error is only one-fortieth of either of the others, and only equal to about one-tenth of an ounce per square inch.

5th. That the errors in the volumes are much less numerous and important with the new formula than with either of the others.

It is also added, that the new expression is simpler in algebraical form than the others; it is more easily calculated, the constants are easier to remember, and that no alteration of the constants in the other formulas will make them coincide so nearly with the truth as the new one does. Lond. Journ. Arts and Sciences.

On Fermentation. By Professor Brande.

The communication, to which this title was given, afforded a general view of that important class of chemical phenomena, of which fermentation is a single example, viz., decompositions and combinations, brought about by causes independent of chemical affinity. Having exhibited striking experiments illustrative of chemical affinity, Mr. Brande called attention to the fact that none of that interchange of the elements of the combining substances, which takes place under the influence of this force, occurs in *catalytic*, or *contact-action*. The phenomena, resulting from catalysis, are of two kinds: 1st, when

the substance producing the effects is altogether passive. The agency of platinum on a mixture of hydrogen and oxygen gases, is a striking instance of this sort of catalytic action. Mr. Brande reminded the members of a communication made by Mr. Faraday, some years since, on this subject. Mr. Faraday then drew attention to the fact, that a clean disk of platinum, immersed in an atmosphere of oxygen and hydrogen gases, mixed in the proportion, by weight, of 8 and 1, caused chemical union, with more, or less, of heat and explosion. Here the acting substance undergoes no change. But, 2nd, in organic catalysis, the substance producing the effects undergoes changes in itself, but does not, as in the case of ordinary chemical affinity, form union with the substance on which it acts. Thus in the case of rennet coagulating milk, or yeast, inducing fermentation in wort, each of these substances interchanges its particles with those of the liquid into which it is immersed, as happens when a plate of iron is plunged into a solution of copper, but the effect is obtained by the motion of the particles of the decomposing body among themselves, creating a corresponding movement in the body subjected to its influence. The decomposing body must be organic, contain nitrogen, and in a state of decay. This is the case with yeast when placed in a vessel of wort. It undergoes a change, connected according to some naturalists, with the growth of a microscope plant, and by this change splits the sugar of the wort into carbonic acid and alcohol. Having noticed the effects of this force of catalysis, Mr. Brande adverted to two theories respecting its nature—the doctrine that the particles of the decomposing body can communicate their motion to an indefinite mass of matter, and the doctrine that each particle of the decomposing body must be, in its turn, presented to every particle of the substances to be acted upon. After pointing out the difficulties inseparable from both these theories, Mr. Brande noticed, apparently with approbation, the simpler doctrine, that, in these cases, the combining force travels from particle to particle, as happens when a train of gunpowder, or an ordinary fire, is lighted. Mr. Brande concluded by adverting to an economical method of brewing, practiced, we believe, with much success in the family of Sir Thomas Marrable. In this method, yeast, as well as the expensive apparatus of coolers, is dispensed with. The wort, after the malt is strained off, is boiled with the hops, and together with the hops deposited in a barrel placed upright, arrangement being made for the escape of the carbonic acid, and for the barrel being completely closed as soon as the fermentation should terminate.—*Trans. Roy. Inst.* Lond. Athenæum.

The Hygro-Barometer. By Mr. Ross.

Mr. Ross explained his hygro-barometer, which has been so arranged that the height of the barometer column, and the depression of the dew point, may be registered from mere inspection, while these two elements are so combined, as to exhibit, in a popular manner, the real state of the weather. The instrument consists of a barometer

of the usual construction, and two thermometers, one of which is of the ordinary kind, and the other has its bulb kept constantly moist by a small skain of silk immersed in water, contained in the fountain bottle placed between the two thermometers. In the centre of the frame is an engraved table of figures, the object of which is to give the number showing the depression of the dew point below the existing temperature. It consists of two columns of figure, the one headed "temperature," and the other the "difference of temperature;" opposite to the figures of the first column, are horizontal columns of figures, which refer to the ordinary thermometer, and the large figures on the upper line of the second column, refer to the difference of the indications of the two thermometers. Above this table is an ivory sliding scale on the right hand, and a fixed scale on the left; the former, which refers to the barometer, is marked with divisions corresponding with tenths of inches, on the scale for measuring the height of the column of mercury on the ordinary barometer, and the latter refers to the hygrometer, and is marked with divisions corresponding with degrees of depression of the dew point, as given by the table; a brass index slides in and moves with the sliding barometric scale, and points to the fixed hygrometric scale, which has the usual words, "rain," "changeable," and "fine," engraved upon it. A blackened index slides in the fixed scales, and is merely to regulate the observation. The places of the various states of the weather, as "rain," "changeable," and "fine," on the hygrometric scale, have been fixed from a mean of three years' Meteorological Journal of the Royal Society, and were obtained in the following manner: when the height of the barometer was thirty inches, and the column of remarks indicated "changeable," the depression of the dew point was taken from its column: and the mean of all cases during the three years gave 6 for the mean depression of the dew point; opposite to six, therefore, "changeable" was accordingly placed. In like manner the place of "fine" was found to correspond with 12, opposite to which it is placed, and the place of "rain" is 0, or where there is no difference between the existing temperature and the dew point.—*Trans. Soc. Arts.*

Ibid.

On the Advantages of employing Large Specula, and Elevated Situations for Astronomical Observations. By C. P. Smith, Esq.

The author adverts to methods proposed by Mr. H. F. Talbot, for the multiplication of copies of specula by means of the electrotype, and for observing astronomical objects with a telescope absolutely fixed, by means of a revolving plane mirror, which methods he considers might, if carried out, produce great improvements in astronomy. Amongst the advantages of the latter method he enumerates the following, arising chiefly from the unlimited focal length which it would be possible to give to the mirror: first, the obviation of the necessity of an accurate parabolic shape for the reflector; secondly, the magnifying of the image without distortion, or color; thirdly, the small effect

which inaccuracies of the screw of the micrometer would produce, eye pieces of low power being employed; fourthly, the elimination of errors dependent on the contraction, or expansion, of the tubes of telescopes; and lastly, the advantage of having the eye in a fixed position. The author then enlarges on the advantages which would attend the use of such a fixed telescope if placed on the slope of a high mountain, with the object-mirror and the eye-piece fixed on piers, and separated by a considerable interval, the mirror being beneath. The Nilgherry hills in India, he instances as being favorable for the purpose, the climate being particularly well suited for astronomical observations. He then answers the obvious objection of the impossibility of reflecting objects from every part of the heavens to the speculum, by assuming that it would be most advantageous for astronomical science, that every observatory should confine itself to those classes of objects which its geographical position enables it most readily to command. He finally dwells upon the cheapness of the labor of computation in India, arising from the circumstances of the great number of Brahmin priests who are willing and competent to undertake the labor for a trifling remuneration.—*Trans. Astron. Soc.*

Ibid.

Cannabic Composition Ornaments.

At the last meeting of the Royal Institute of British Architects, and the Institution of Civil Engineers, several ornaments of this new material for decoration were exhibited. Any new material that may facilitate the introduction of ornaments into our dwellings, cannot be otherwise than acceptable, for, fortunately, a great demand exists in the present day for decorations.

The Cannabic composition is an Italian invention, which, although it has been some years in existence, has only lately been brought to such a degree of advancement, as to justify its introduction into this country. The material which is used in this composition is the common hemp, which possessing great tenacity, and equal pliability at the same time that it is procured in abundance, and at a moderate price, affords every facility for carrying out the invention. It admits of application to any internal architectural ornament, as ceilings, bosses, truss moulding, brackets, panels, capitals, pilasters, and mouldings of every kind, and in every style, as well as for external purposes. It has an exceedingly good surface, admitting of any kind of varnish, paint, or finish. For gilding it is most admirably adapted, likewise for painting, varnishing, burnishing, and bronzing, as may be seen, by specimens at Mr. Ponsonby's, the gilder and decorator in Piccadilly. It takes a beautiful bronze color, and by gilding acquires quite a metallic surface and high burnish. The advantage of these properties in decoration will be well appreciated by the architect, as giving new resources for carrying out his ideas. Neither are the consistency and durability of the material less observable, being at the same time hard and elastic. From these properties it is not liable to crack when put up in a room. It possesses a great degree of

sharpness and boldness, which, it is the intention of the patentees to increase by using a greater degree of mechanical power. It is such a light material that it admits of being put up in large masses on ceilings, and in other situations, in relief. With regard to external properties, it is not at all affected by wet, nor by the vicissitudes of the atmosphere, being water proof. In centre pieces for ceiling, door panels, and other compositions, as it admits of being executed in larger pieces, it is much less troublesome than the ordinary materials. The number of patterns for selection in the cannabic material at the present moment amounts to about four hundred, many of them quite new; but this number will speedily be increased, while the patentee will be most happy to afford every facility to architects who may wish to have patterns executed from their own designs.

The price, it is stated, ranges from about 10 to 20 per cent. below the prices of articles in common use, and it is on this ground that the patentees expect its extensive application. For decoration in the colonies and the East and West Indies, great difficulties at present exist, as most materials suffer rapid deterioration from the climate. The supply of a durable and cheap material, will, therefore, be the means of extending ornamental decorations in our extensive possessions: it is likewise well adapted for the decoration of steam vessels.

Civ. Eng. and Arch. Jour.

Preparation of a beautiful Green Color without Arsenic.

48 lbs. of sulphate of copper and 2 lbs. of bichromate of potash are dissolved in the requisite quantity of water, and 2 lbs. of carbonate of potash, (pearlash) and 1 lb. of chalk added to the clear solution. The precipitate is pressed, dried, and rubbed to a powder. This color is not so beautiful as the Schweinfurth green, but is peculiarly well adapted for painting dwelling rooms and work shops, there being no fear of any poisoning from arsenic.

By varying the proportions a number of different tints of this color may be obtained.—*Bittheilungen des Böhm. Gewerbevereins*, 1842 page 733.

Chemical Gazette.

Automaton Calculator.

Dr. Roth's automaton calculator was exhibited, and its action explained by Mr. Wertheimber. He gave a short review of the various attempts at constructing calculating machines, noticing the Roman Abacus, the calculating boxes of the Chinese and Russians; the several classes of instruments invented by Napier in 1617, by Perrault, and others, in 1720, and, subsequently, the slide rule invented by Michael Scheffelt, of Ulm, in 1699; the more important machines attempted by Pascal in 1640, by Moreland in 1673, by Gersten, and Leibnitz, which were submitted to the Royal Society of London, and the Académie des Sciences in Paris; he then mentioned the machine

of Mr. Babbage, upon which upwards of £20,000 had been expended before the project was abandoned, and the finished part, which formed tables of progression up to five figures, was consigned to the museum of King's College, London. Dr. Roth's machine appeared very simple, and its results, which were severally tested, were very accurate; it performed all the operations of arithmetic from simple addition, subtraction, multiplication, and division of numbers, or of pounds, shillings, and pence, to vulgar and decimal fractions, involution and evolution, and arithmetical and geometrical progression; it appeared particularly adapted for checking long calculations of quantities, for contractors, for merchant's counting house, or for government offices. The same principle had been adopted as counters for rotary, or reciprocating, machines, and they appeared from the compactness of their form, and their regularity of action, to be well adapted for the purpose.

Civ. Eng. & Arch. Journ.

Braithwaite's Process of Producing Imitations of Carving in Wood.

This invention was first produced in France, but has not been carried out to any great extent in that country.

In the carving of wood, as usually performed, two persons are employed, the one to cut out the intended subject in the rough, and the other to finish it. When a particular design is required to be executed by Mr. Braithwaite's process, a mould is made of cast-iron of the intended pattern, which is then heated to "cherry-red;" the heated mould being placed ready to receive the wood, viz., oak, chesnut, or other hard wood, to be acted on; the piece of wood is then rapidly, and with a power of from ten to thirty tons, according to the depth of the ornament, pressed into the mould by means of a lever press; and this is repeated until the full relief is obtained. The wood is then thrown into cold water, the charred surface being afterwards scraped, or brushed, off, after each application to the mould. After about 250 impressions have been taken off, the mould requires chasing; the whole number of impressions that may be taken from one mould is from 400 to 500.

Trans. Soc. Arts, &c.

Experiments on Coffee. *By* James J. Cunningham.

The object of the present communication has reference to some experiments on coffee, which, I think, possess some novelty, if they have no other merit. It is well known that this article, during the process of roasting, loses from 19 to 25 per cent. of its weight, this is principally water evaporated at the very high temperature it is exposed to. I speculated that if this moisture could be previously withdrawn, *without the application of heat*, a much shorter exposure to a high temperature would afterwards be required to complete the

process, and that an equivalent improvement in the quality might be looked for.

To test this I accurately weighed two packages of the same Jamaica coffee, each containing 8 ounces: one package, made up in paper, I inclosed in a jar with a very close cover, containing a quantity of fresh burned quick-lime; the second package I kept by me; I anticipated that the lime would attract the moisture from the inclosed air, and that the air would in its turn take the moisture from the coffee. After two months I opened the jar; the coffee did not appear shrunk, and was but very slightly altered in color, but on weighing it I found it reduced to 6⅞ ozs., thus showing a loss of nearly 15 per cent. I separately roasted the two samples; the one I had kept by me still weighed 8 ozs.; it took the usual time, and when weighed was 6½ ozs.; the second sample had scarcely been raised to the required temperature, when it suddenly swelled, and the process was complete in much less than one-third the usual time; when weighed it was 6⅜ ozs. The following table will give a synopsis; No. 1, is the coffee that was treated with lime:—

No.	Weight before desiccation.	Weight after desiccation.	Weight when roasted.
1	8 ounces.	6.875 ounces.	6.625 ounces.
2	8 ...	.....	6.500 ...

It will be observed that the sample No. 1, weighed more after roasting than No. 2. Part of this increase might have been caused by the latter being a little more highly roasted, but I am confident that this would not account for so great a difference in so small a quantity. The two samples were now ground, and prepared in the usual manner; the quality of No. 1, was much better than the other, being stronger, more aromatic, and finer in flavor.

Lond., Edin. & Dub. Phil. Mag.

BIBLIOGRAPHICAL NOTICE.

Observations on Vegetable and Animal Physiology. By WILLIAM L. WIGHT, M. D., Petersburg, Virginia: pp. 36, 8vo.

In the essay before us the author has attempted to explain many of the phenomena which take place in the growth and development of plants and animals, in doing which he calls into requisition the results of the latest researches of science, aided by observations and experiments made by himself. The interest taken in such subjects is at present very general and strong, and, we think, one of the best proofs of this is afforded by the rapid sale in the United States of perhaps more than 20,000 copies of Liebig's late essays upon vegeta-

ble and animal chemistry. From such investigations agriculture and medicine must be greatly advanced, as many of the phenomena of vegetation and the animal functions, both in health and disease, are deprived of the obscurity which has hitherto enveloped them. But Dr. Wight does not restrict his inquiries to the growth and nourishment of plants, the play of animal functions in a healthy condition, with the analogies and distinctive features of the vegetable and animal kingdom. He goes further, and applies the laws and facts of electro-chemistry to explain the morbid phenomena connected with pathology, or the derangements of healthy action. His views upon all the topics referred to are highly interesting to the general reader, and more especially so to numbers of his profession. They are recommended by their ingenuity and boldness, and certainly reflect great credit upon their intelligent author.

Lunar Occultations.

Lunar Occultations visible in Philadelphia during the month of June, 1844; computed by Mrs. Charlotte S. Downes, from the Elements published with the Occultation list of the United States Almanac.

The Immersions and Emersions are for Philadelphia, mean astronomical time. Im. for Immersion, Em. for Emersion. These abbreviations in *Italics* refer to those Immersions and Emersions which take place on the Moon's dark limb. N. App. for Near Approach.

The angles are for *inverted image*, or as seen in an astronomical telescope, and reckoned from the Moon's North point and from its Vertex around through East, South, West, to North and Vertex again. For direct vision add 180°.

JUNE, 1844.

Day.	H'r.	Min.	Star's name.	Mag.	From North.	From Vertex.
7	14	4	Im. 16 Piscium,	6	28°	78°
	14	57	*Em.*		280	328
11	17	27	N. App. 40 Arietis, ☽ N. 0′.1,	6		
15	8	3	N. App. κ Cancri, ☽ N. 0′.7,	6		
19	7	37	*Im.* Bessel,	9	124	73
	8	38	Em.		286	234
19	8	41	N. App. Bessel, ☽ N, 1′.0,	9		
20	7	29	*Im.* Bessel,	9	116	69
	8	35	Em.		299	250
20	8	30	*Im.* Bessel,	8	116	65
	9	30	Em.		294	243
21	9	41	*Im.* Bessel,	8	98	48
	10	37	Em.		309	259
21	9	55	*Im.* Bessel,	8.9	75	25
	10	40	Em.		332	282
21	10	20	*Im.* Bessel,	8.9	101	51
	11	14	Em.		304	254
21	10	30	*Im.* Bessel,	9.10	119	69
	11	24	Em.		286	236
23	11	15	*Im.* q Virginis,	5.6	68	20
	11	59	Em.		331	281
27	8	7	Im. g Ophiuchi,	5	143	167
	9	11	*Em.*		248	260